SEPTEMBER 1961

World Oil

EXPLORATION • DRILLING • PRODUCTION

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REDS' OIL OFFENSIVE

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PART 2

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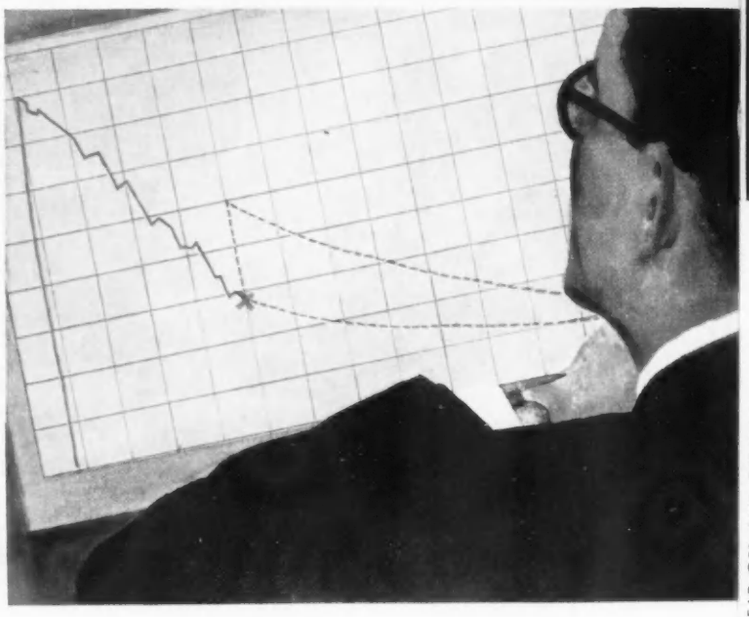

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FOR EXPLORATION, DRILLING AND PRODUCING ENGINEERING OPERATIONS AND MANAGEMENT

"He who receives an idea from me, receives instruction himself without lessening mine; as he who lights his taper at mine receives light without darkening me."
—Thomas Jefferson.

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QUICK LOOK at this issue

To help you put first things first, scan these time-saving digests, checking those you want to read first.

☐ **How the flood of Red oil can be dammed . . .** For the first time, here is a complete, in depth appraisal of Russia's use of oil in the economic Cold War. World Oil has checked every available source to evaluate the problems imposed by increased Russian exports of oil to the Free World countries, and ways to dull the effectiveness of this vicious economic weapon. For an incisive look at this significant milestone in world history turn to ..... **Page 71**

☐ **Small diameter well completions—Part 2 . . .** Many factors influence casing programs for small diameter wells, and especially multiple parallel string completions. This section of Engineering Practices Report No. 4 includes a detailed description of eight different single well casing hook-ups and six multiple string installations. By combining the programs included, many variations can be devised. Small diameter primary cementing equipment also is described. See . . . . **Page 79**

☐ **High aeromagnetic accuracy provides detailed coverage . . .** In the first of a series of five articles on magnetic and micromagnetic exploration for oil and gas, the high resolving capability of dual-level aerial magnetic surveys for use in micromagnetic interpretation is shown. This method combines the speed of airborne operations with detailed geophysical and geological interpretation ..... **Page 90**

☐ **New hydrocarbon extraction unit designed for small, rich gas streams . . .** Skid mounted, packaged low temperature separation units using compression refrigeration cycle can economically dehydrate and extract liquid hydrocarbons from field gas streams as small as 500 Mcfd. This article describes operation of the new unit and discusses its various applications. See ..... **Page 93**

☐ **High pressure CO_2 treatments boost production . . .** Discharge of high pressure carbon dioxide gas opposite productive intervals unplugs blocked formations, lowers breakdown pressures prior to stimu-

lation treatments and cleans face of open hole producing sections. No casing damage has been reported although discharge pressures average 17,500 psi. For a complete description of this new remedial technique, see **Page 97.**

☐ **Mathematical probability is an oil-search tool . . .** Contrary to the belief of many geologists, there are a number of mathematical concepts that can be helpful in solving some exploration problems. An independent producer has based his development and growth mainly on reduction of geological and reservoir data to digital terms and processing it in electronic computers to evaluate subsurface prospects. The firm has 5,200 acres of productive leases after three years of operations and has an 82 percent drilling success ratio despite a high proportion of wildcats. . . . . **Page 99**

☐ **Gas drilling reduces costs in Mississippi . . .** Shell Oil Company recently saved $100,000 using gas as the circulating medium in the Jarrett et al Unit 1 Siloam field, Clay County, Mississippi. Use of gas resulted in saving 70.5 drilling days, in a reduction of 93 bits, and a savings of $10,040 in the circulating medium. For complete details, see. . . . . **Page 107**

☐ **"Suitcase seismic" records obtained from 4,000 feet . . .** Miniaturized seismograph field assemblies involving only 216 pounds of equipment, recording reflected impulses from explosive charges of from 2 ounces to 2 pounds have produced good records indicative of reflecting horizons as deep as 4,000 feet in central Oklahoma. Here's a brief illustrated discussion of the technique, instrumentation, equipment and geology . . . . . **Page 119**

☐ **New discoveries spur Nebraska activity . . .** The active rotary census in Nebraska rose above 40 rigs in early summer, considerably more than were reported in Wyoming, the second most active Rocky Mountain State. Six southwest Nebraska counties in the Cambridge Arch area accounted for most of the jump in Nebraska activity. For complete details on this active independent play, turn to. . . . . **Page 122**

☐ **New offshore floating vessel to drill in any depth of water . . .** Global Marine Exploration Company is presently constructing a new version of CUSS 1. This new vessel is being completely designed from the keel up; whereby the CUSS 1 was a modified version of a Navy barge. This offshore craft will be fitted out and equipped to drill to depths in excess of 15,000 feet in any water depth. It is presently under construction and should be in operation the early part of 1962. See. . . . . **Page 124**

Oil Industry In Brief

Demand stagnates. During first 7 months of '61, total demand for all oils averaged 9.9 million barrels daily, up only 0.3 percent over same '60 period. Forecasts are for 2.6-3 percent rise in last two quarters, bringing yearly total up about 1.6 percent over '60. See Page 14.

Stocks increase. On July 31, stocks of all oils totaled 830.3 million barrels, up 36.3 million barrels or 4.6 percent over same '60 date. See Page 14.

Imports up sharply. Crude and products imports averaged 1.96 million barrels daily during four-week period ending August 11—up 292,000 barrels daily or 14.9 percent over same '60 period.

Production to increase slightly. Forecasts are that U.S. crude production will average 7,060,000 barrels daily in third quarter, up 2 percent over same '60 period—and 7,117,000 barrels daily in fourth quarter, up 0.5 percent over '60.

New wells increase. Operators completed average of 129 new wells daily during July, up 3.2 percent over June's 125 wells—and up 2.7 percent over July 1960. See Page 18.

Rig totals improve. 3,664 rigs were operating on July 31, up 183 rigs or 5.3 percent over June's end, and 7.6 percent over July 31, '60. See page 18.

More gas wells. Total gas well completions increased 19.4 percent during first 7 months of '61, while oil well completions dropped 6.3 percent from same '60 period, to 11,933 wells. See Page 18.

Watch for your Drilling Progress Issue in October

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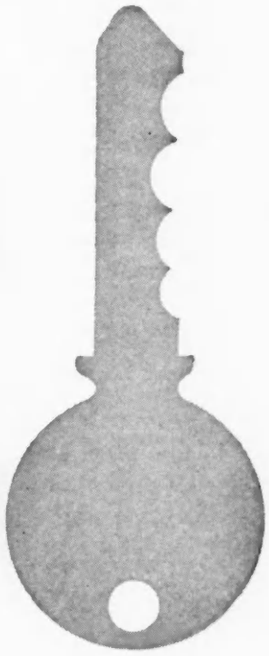

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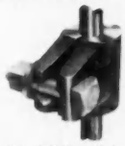

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Looking Ahead

Another new trend in multiple completions? . . . Sun Oil Company is using a new wireline multiple completion tool to produce two separate reservoirs simultaneously through a single tubing string. Production from each reservoir can be accurately determined.

Advantages: one tubing string required for two reservoirs—excess energy from one zone can be used to lift the weaker well—current income is increased and costs are cut—completions are economically made in doubtful zones not considered worthy of a twin tubing string installation.

In one South Louisiana well, annual gross income was increased $48,400 with a net reduction in operating costs. (Watch for a complete technical report on this new technique in your October issue of WORLD OIL).

New directional turbodrill on the way . . . Using a new technique in which the turbodrill is controlled by a specially designed deflection method, Eastman Oil Well Survey makes this report on a successful Texas test: Total dogleg of 3¾° was equally distributed over entire 40-foot run. Drilling was fast and accurate. Economics seem to be in the ball park.

Indications are that Eastman's directional turbodrilling will permit use of full gage bit, eliminating hole opening—introduces uniform curvature to hole instead of sharp dogleg—cleans out bridges or drills out fill, eliminating hole conditioning runs—permits length of run that will allow normal amount of drill collars to be used on following run.

Washington briefs . . . Latest boxscore on mass turnover in key Washington oil and gas posts: J. Cordell Moore, 49, a 25-year government career man with a smidgeon of oil experience, has been named head of the Oil Import Administration, replacing Lawrence J. O'Connor who, despite Senator Proximire, was named to Federal Power Commission. Still vacant is FPC post vacated by Frederick Stueck's sudden death; also Office of Oil and Gas Director for the Interior Department which has had a rather nebulous existence since Captain Mathew V. Carson wore both the Oil Imports and Office of Oil and Gas hats prior to O'Connor's arrival on the Washington scene . . . **Twenty-nine natural gas producers** have filed joint comments stating that FPC Presiding Examiner Edward Marsh did not accurately reflect their position when he stated in proposed report on South Louisiana area price hearing that "they will support a single area price only if it is equal to, or higher than, any contract price involved in the proceeding." Producers say they want to give area pricing a fair trial and will cooperate fully, but are opposed to so-called "pay-out" method of initial rate determination . . . **Crude oil and product imports were up 17.5 percent over 1960 during four-week period ending August 11,** averaging 1.96 million barrels per day . . . **Depletion provision opponents are gathering ammunition,** will be ready to fire with all barrels in next session of Congress. Provision will have its stiffest test in '62 . . . **Still chafing under prolonged siege of eight-day proration schedules,** Texas Independent Producers and Royalty Owners Association announces it may soon propose its own "new and workable Oil Import Control plan."

BuMines seeks new way to evaluate oil shales . . . Instead of using slower and more expensive core drilling to evaluate shale deposits, BuMines is now working with others in eastern Utah to see whether modern oil and gas well drilling and logging methods can be substituted. Initial studies center on two holes in Uintah County, Utah.

Oil shales occur in 30 states, with the most promising reserves to date occurring in the Piceance Creek Basin of Colorado (more than 1 trillion barrels), followed by Utah with 120 billion barrels and Wyoming with 12 billion.

Good Wells Make Good News

Recent Frac Treatments That Solved Special Production Problems

September, 1961

Knotty production problems can often be solved by Dowell fracturing treatments. Dowell has many modern tools to help both in planning and in performing frac jobs, whether routine or complex. Some of these advancements include the Frac Guide*, computer calculations and fracture conductivity tests. Here are four recent examples of Dowell frac jobs that solved special production problems:

- **Ashtabula County, Ohio** (New Oil Well) Pay zone was the low permeability, low porosity Medina sand. Perforations were from 3760 to 3765 feet. Other wells in the area, given small frac jobs, have been poor producers with rapid decline rates. Dowell engineered a treatment with the aid of the Frac Guide. 37,000 gallons water with FLA* fluid loss additive carried 66,000 pounds sand. Injection rate was 50 bpm. *Before treatment, well made show. After treatment, production was scheduled at 160 bopd through a 1/16th-inch choke.*

- **Andrews County, West Texas** (New Oil Well) This well had been abandoned after previous treatment efforts had failed to result in commercial production. Several cement squeeze jobs had been performed. Perforations into the Devonian were from 12,040 to 12,045 and from 12,063 to 12,073 feet. Dowell used Acid Petrofrac* fracturing service. 50,000 gallons acid-oil emulsion and 13,000 pounds sand were injected down tubing at pressures up to 7500 psi. *After treatment, well tested 463 bopd flowing through a 24/64th-inch choke.*

- **Muhlenberg County, Kentucky** (New Oil Well) Dowell used Abrasijet* abrasive jetting service to perforate into the Paint Creek sand between 1909 and 1920 feet. Well was then treated down casing. A spearhead of 1000 gallons kerosene with Freflo* surface active agent was followed by frac job. 17,000 gallons lease crude, 20,000 pounds sand and 800 pounds of a fluid loss control agent were used. *45 days after treatment, well was still making 160 bopd. An offset shot with nitro made 80 bopd.*

- **Hutchison County, Texas Panhandle** (Old Oil Well) This is one of the many shallow wells completed into the Dolomite of the Panhandle field. The problem was to fracture several zones in stages. The pay has very low structural strength. Later stages of a frac job are likely to break past the cement bond into the zone fractured first. Dowell engineers designed a treatment that employed a gel diverting agent followed by permeable ball sealers. *Operator reported that the production increase was 30 percent above increases obtained from previous treatments on other wells in the area.*

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Given a chance, industry CAN help

THE WASHINGTON MERRY-GO-ROUND has been cranked up again. And this time the oil industry is footing a sizable portion of the bill in an integrated move to help a federal agency unravel an impossible web of circumstances resulting from an ill-advised and apparently unilateral action.

The latest problem from the Potomac surrounds the inclusion of oil field rig movements in new regulations of the Federal Aviation Agency, which require notifications on all structures exceeding 150 feet in height. These regulations, effective July 15, require:

1. Notification to FAA 30 days prior to beginning construction of any structure which will have a height of 150 feet above ground or water level.

2. Another notice to FAA when the construction of the structure reaches the 150-foot height.

In cases where structures may be considered a hazard to air navigation, the regulations also provide procedures for studies, hearings and appeals from FAA determinations.

These regulations began attracting widening interest among oil drilling and producing people immediately after their effective date. In quick succession, the following meetings were held, leading to a joint protest by American Petroleum Institute's Division of Production and American Association of Oilwell Drilling Contractors:

- July 21 in Dallas. Fifteen drilling contractors and major oil company personnel convened, discussed and decided to seek administrative correction. A drafting committee, by working over the weekend, completed a 7,000-word statement by Monday morning. A personal carrier took a 5 p.m. plane to Washington. This decisive action led to the next meeting.
- August 8 in Washington. Oil industry representatives met with FAA officials, and the problems arising in drilling and production operations from these regulations were discussed. FAA officials, while they could not make any promises, did indicate an understanding of the problem and said the matter would be given further study.

Since it was impossible to predict any administrative relaxation, it was decided that court relief would be sought before the deadline for such action—August 11—erased this possible source of relief.

So, on August 11, API and AAODC jointly filed a motion for review with the U.S. Circuit Court of Appeals, Fifth District, at New Orleans. This action was supplemented on August 14 by the filing of a motion for stay of enforcement of the FAA regulations until the matter could be heard on its merits.

Lack of administrative action, as matters stand at WORLD OIL's press time, will likely result in court action on the petitions. Should the court grant a stay, it would set aside application of FAA regulations to the movement of drilling rigs until after the full court convenes in December.

There, in an economy-sized nutshell, is the situation. As WORLD OIL neared publication date, it was possible that either the court would act on the petitions or that the FAA would agree to stay of its regulations until it completes its study.

The importance of administrative relaxation in this instance is underscored by the following joint statement from Warren L. Baker, executive vice president, AAODC, and Wm. H. Strang, Director, Division of Production, API:

"It would be extremely difficult for the petroleum industry to comply with FAA regulations. They would impose an intolerable burden upon the industry by creating many difficulties, and would not serve the interests of air safety because of the temporary nature of drilling rigs."

Among the difficulties which would arise from enforcement of the FAA regulations, they explained, are:

- The large number of notifications for both the industry and FAA to process.
- Frequency and rapidity with which drilling rigs are moved.
- Difficulty of giving notice 30 days in advance of proposed drilling sites and the undesirability of giving advance notice because of the confidential nature of intended drilling sites.
- Rapidity with which derricks, especially masts, are erected once upon the site.
- Necessity for quick rig moves in many instances.
- Possible loss of leases in some instances.
- General location of drilling sites away from urban areas and other conditions which make drilling operations unique and distinct from other more permanent installations.

But what is, perhaps, even more important and far-reaching is that this complex situation need not have arisen in the first place.

WORLD OIL is not taking FAA to task for doing the job it believes should be done. But, for the luvva Mike, why do the innumerable agencies and bureaus of the federal government exhibit such a reluctance to ask for industry advice before adopting regulations that are contrary to the best interests of industry. For what is contrary to the best interests of industry certainly is contrary to the best interests of the federal government.

If industry advice were sought in many areas before government action (and this case serves as one more good example) is taken, there is a growing feeling that there would be less backtracking and less money spent by the government as well as industry to iron out problems resulting from premature action.

Donald E. Kliewer

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For one thing, it takes time—years of performance studies. We've sweated out failures and assessed our successes—sifted out weak points and strengthened the strong points.

This great packer is at work right now in tens of thousands of wells—the average wells, the corrosive wells, the deep, hot, high pressure wells.

THAT'S A TOUGH proving ground—one that has helped us soak up a vast knowledge of what happens to slips, packing elements, and the like, when a packer is downhole. We've got the facts.

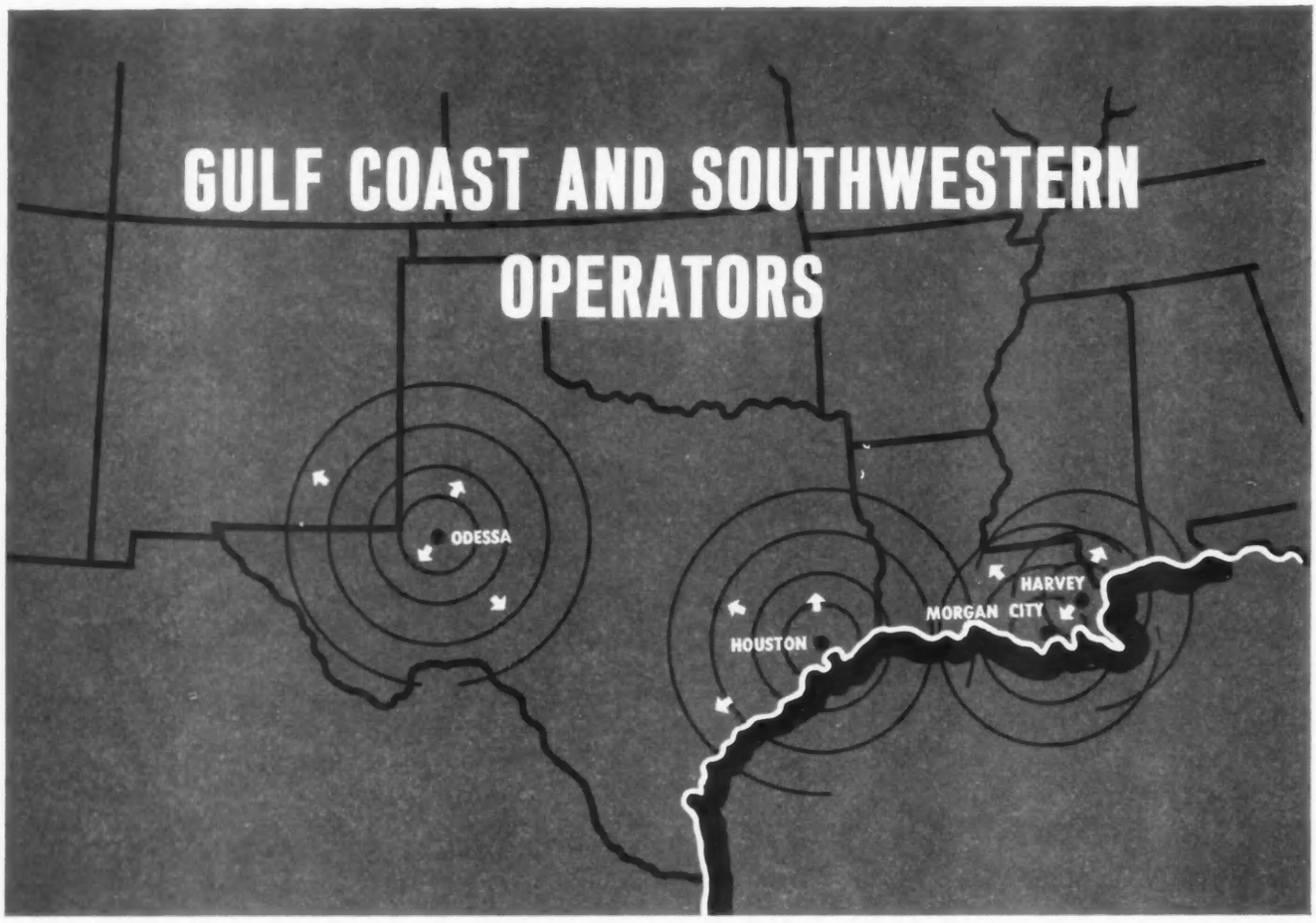
Baker made the first retainer packer—for many years the *only* retainer-type packer. The result is a wealth of packer experience that's hard to equal.

This remarkable packer shows it. Over the years we've refined it into a tool that has unyielding stamina. That's why we can call it the most predictable packer of them all.

BAKER

RETAINER PRODUCTION PACKER

BAKER OIL TOOLS, INC. HOUSTON / LOS ANGELES / NEW YORK



Plastic Applicators' four strategically located pipe-coating plants can help you cut tubing inventories, speed coated-tubing deliveries, and reduce freight costs for both new and used tubing.

Many operators now keep their capital investment in tubing inventory low by purchasing locally from supply stores or mill stock, in quantities to meet only current needs. Usually an operator's inventory can be smaller if he can have his tubing coated quickly at a nearby plant. Such minimum-investment purchasing is especially practical for most Gulf Coast and Permian Basin operators because four conveniently located Plastic Applicators' plants at Harvey and Morgan City, Louisiana, and Houston and Odessa, Texas, give them quick delivery.

The strategic locations of these plants also help operators keep their freight costs low. (An added convenience is the full range of in-plant inspection services for new and used pipe offered by Plastic Applicators' Pipe Inspection Division. Money-saving combination coating-and-inspection rates are available)

Call a nearby Plastic Applicators plant or sales office today for the complete story on how Plastic Applicators' conveniently located plants and on-time deliveries can help you cut costs.

LOCATIONS:

Main Office: *7020 Katy Road, P. O. Box 7631, Houston, Tex., UN 9-3611. Plants: Harvey and Morgan City, La. Houston and Odessa, Tex.*

Sales Offices: *Midland and Corpus Christi, Tex.; Hobbs, N.M.; Tulsa, Okla.; Houma, Lafayette, New Orleans, and Shreveport, La.; Jackson, Miss.*

BETTER COATINGS THROUGH RESEARCH

PLASTIC APPLICATORS, INC.

It's good to know you've got a BAKER float valve in your drilling string...

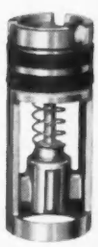
and it costs so little for this convenience and protection

Many drillers consider no string fully made up without a Baker Drill Pipe Float Valve. Why? Because float valves afford a lot of convenience and protection for very little investment.

Baker makes two good drill pipe float valves. The Model "F" is the time-proven poppet-valve type. The Model "G" is the new full-flow flapper-valve type.

Whichever you choose, you get such advantages as freedom from plugged bits and the annoyance of having to pull wet strings, prevention of blowouts through the drill pipe when drilling through high pressure zones, and extended life of brake bands and wire lines by relieving weight on the rig equipment.

Baker Drill Pipe Float Valves are easily installed and serviced. At your supply store in sizes to fit all popular tool joints.



MODEL "F"
(poppet-valve type)
Product 4813

This efficient model has been run successfully in more wells throughout the world than any other float valve. The only servicing normally required is an occasional replacement of the valve seal. Use in float body or bored-out drill collar.

MODEL "G"
(flapper-valve type)
Product 483-G

This model features full and unrestricted flow through its bore. Its sensitive valve is fast acting which results in a kind of service unmatched by other valves. This valve can be furnished, on special order, in fill-up and air-drilling versions.

BAKER

BAKER OIL TOOLS, INC.

HOUSTON/LOS ANGELES/NEW YORK

Oil use growing slowly in recent years

By WORLD OIL Staff

A PERSISTENT LACK of growth in petroleum use in 1961 has been a major cause of weak markets and sagging prices for oils in recent months. Until a few years ago, petroleum demand frequently increased 4 or 5 percent or more per year. And at the beginning of this year the industry was expecting a gain of at least 2 percent. But even that expectation has failed to materialize. In the first 7 months of 1961 the total demand for oils averaged 9,915,000 barrels daily, up only 26,000 bpd or 0.3 percent over the like period of 1960.

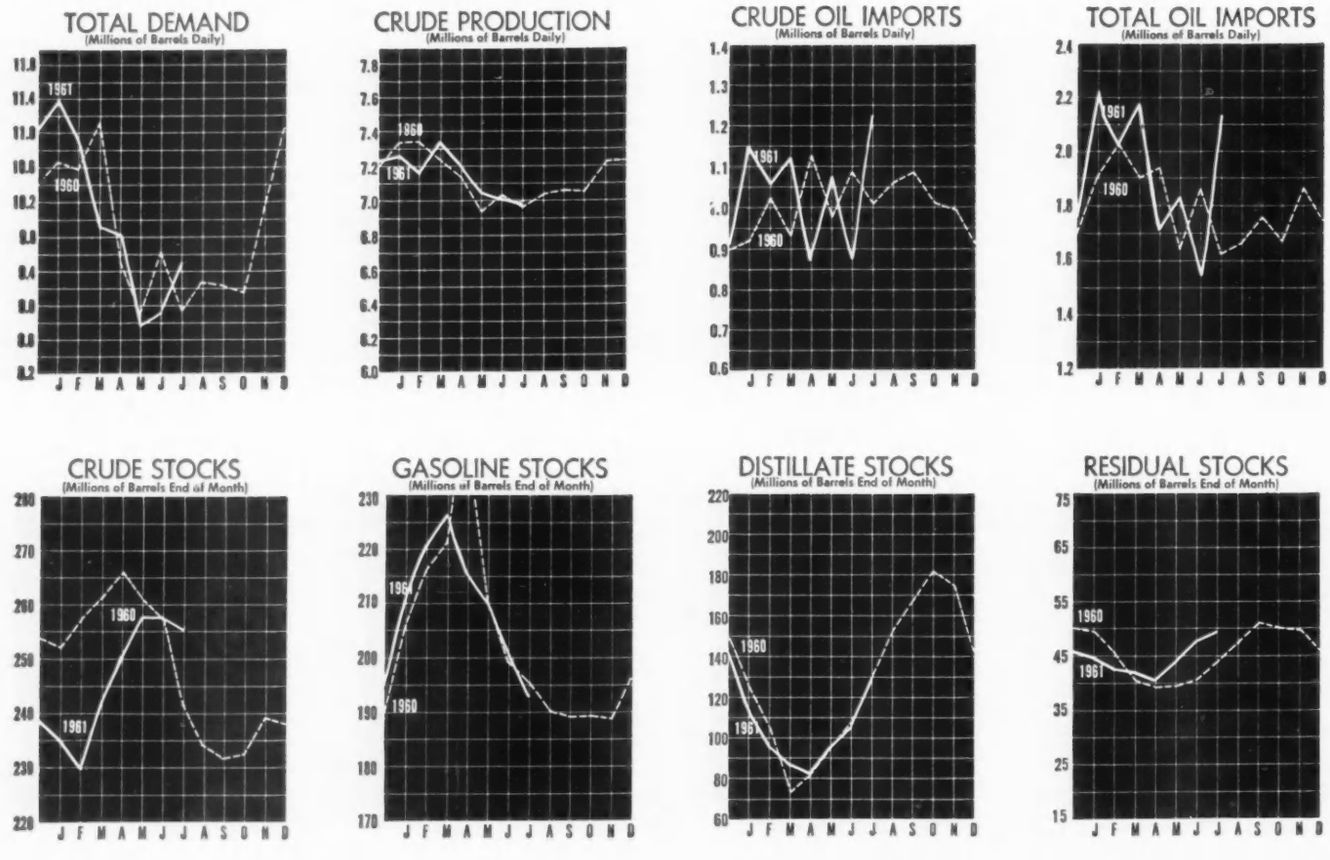
There are firm forecasts, however, that better gains will occur in the remainder of this year. The Bureau of Mines has forecast increases of 3 percent for the third quarter and 2.6 percent for the fourth quarter. Fulfillment of those forecasts would put total demand for 1961 up 157,000 barrels daily or 1.6 percent over 1960, to 10,036,000 bpd.

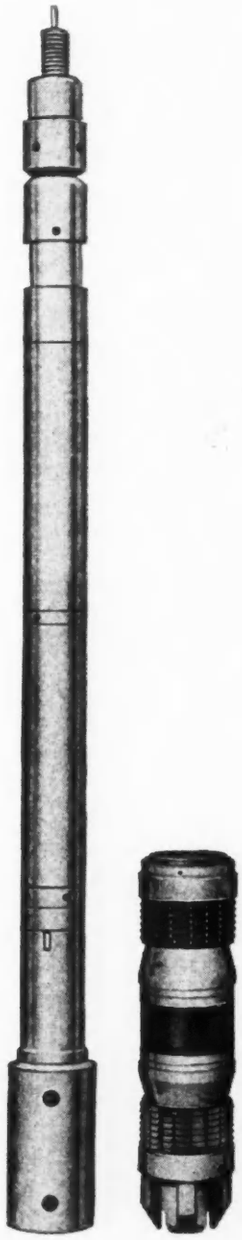
These prospective increases in oil consumption offer some encouragement. They would help to absorb currently available supplies of crude and products and would aid in keeping stocks within satisfactory limits. Based on those estimates, the bureau figured that U.S. crude oil production would be required in the volume of 7,060,000 barels daily in the third quarter, an increase of 137,000 bpd or 2 percent over the third quarter of 1960. It computed that in the fourth quarter crude output of 7,117,000 bpd would be needed, a gain of 37,000 bpd or 0.5 percent over last year.

While increases of these sizes are helpful, they are relatively small. An industry can be stable and show gradual, steady growth when its sales regularly expand by 1½ or 2 percent per year. Such gains are the record for the past five years. But these increases are only about in line with the normal growth in population. They do not indicate any increases in oil consumption per person.

A significant thing about the trend of petroleum consumption is the fact that the relatively slow growth of demand has persisted for five years. The demand increased 4.3 percent in 1956 but subsequently has risen only around 2 percent per year. It rose 1.9 percent in 1957, decreased 0.3 percent in 1958, increased 3.2 percent in

Petroleum Trends...





Baker Wire Line Pressure Setting Assembly, Product 437

Baker Wire Line Bridge Plug, Product 400-N

RUNNING MATES

A Baker Bridge Plug is tough and reliable. So is a Baker Wire Line Pressure Setting Assembly. They're running mates—a matched pair. They've been working together for years, building a reputation for dependability.

The average wells or the hot, high pressure wells—a Baker Bridge Plug masters them all. Whether you measure its life span in hours or in years, it's got what it takes to do its job.

Setting a plug on wire line today is a simple operation, and a fast and sure one. What makes that possible is the Baker wire line setting tool. A good setting tool is as important as a good plug.

Like the bridge plug itself, the setting tool is a Baker innovation. A Baker plug and Baker setting tool work well together because they were designed to do just that.

Leading wire line service companies set Baker Wire Line Bridge Plugs accurately and promptly using the Baker Wire Line Pressure Setting Assembly.

Other models of Baker Bridge Plugs can be set on tubing or drill pipe. They are all made in drillable, corrosion-resistant cast iron for permanent service, and in fast-drilling magnesium for temporary service.

BAKER WIRE LINE BRIDGE PLUGS

BAKER OIL TOOLS, INC. / HOUSTON / LOS ANGELES / NEW YORK

BAKER

U. S. Petroleum Demand and Supply (Thous. Bbls. Daily)

ITEM	July 1961	July 1960	% Diff.	June 1961	January-July 1961	January-July 1960	% Diff.
DEMAND							
All Oils, Total Demand	9,583	8,937	+ 7.2	8,915	9,915	9,889	+ 0.3
Domestic Demand	9,398	8,744	+ 7.5	8,735	9,736	9,677	+ 0.6
Export Demand	185	193	— 4.1	180	179	212	— 15.6
Gasoline, Total Demand	4,526	4,418	+ 2.4	4,483	4,158	4,146	+ 0.3
Distillate, Total Demand	1,321	1,156	+14.3	1,176	1,954	1,942	+ 0.6
Kerosine, Total Demand	285	261	+ 9.2	256	376	346	+ 8.7
Residual, Total Demand	1,383	1,216	+13.7	1,249	1,581	1,650	— 4.2
Other Oils, Total Demand	2,068	1,886	+ 9.6	1,751	1,846	1,805	+ 2.3
CHANGE IN STOCKS							
All Oils, Change in Stocks	+461	+459		+643	+265	— 72	
NEW SUPPLY							
Total New Supply	10,044	9,396	+ 6.9	9,558	10,133	9,817	+ 3.2
Domestic Production, Total	7,912	7,759	+ 2.0	7,970	8,184	7,965	+ 2.7
Crude Oil	6,957	6,860	+ 1.4	7,035	7,205	7,039	+ 2.4
Natural Gas Liquids	955	899	+ 6.2	935	979	926	+ 5.7
Imports, Total	2,132	1,637	+30.2	1,588	1,949	1,852	+ 5.2
Refined Products	898	631	+42.3	704	906	838	+ 8.1
Crude Oil, Total	1,234	1,006	+22.7	884	1,043	1,014	+ 2.9
Crude, East of California	811	749	+ 8.3	656	746	756	— 1.3
CRUDE RUNS							
Crude Runs to Stills	8,242	8,307	— 0.8	8,022	8,145	8,089	+ 0.7
Domestic Crude	7,144	7,230	— 1.2	6,999	7,117	7,077	+ 0.6
Foreign	1,098	1,077	+ 1.9	1,023	1,028	1,012	+ 1.6

U. S. Stocks of Oils (Million Bbls. at End of Month)

KIND OF OIL	TOTAL IN U.S. July 1961	July 1960	% Diff.	June 1961	EAST OF CALIFORNIA July 1961	July 1960	% Diff.	June 1961
All Oils	830.3	793.7	+ 4.6	816.0				
Crude Oil	255.9	242.7	+ 5.4	257.4	256.0	212.1	+20.7	230.1
Natural Gas Liquids	39.5	32.5	+21.5	38.5				
Gasoline	193.5	196.0	— 1.3	200.1	167.8	166.7	+ 0.7	174.0
Distillate Fuel Oil	131.7	131.0	+ 0.5	113.1	116.6	118.0	— 1.2	99.5
Kerosine	32.1	30.5	+ 5.2	29.8	30.4	29.1	+ 4.5	28.3
Residual Fuel	49.8	43.8	+13.7	47.6	31.4	29.6	+ 6.1	29.2
Other Products	127.8	117.2	+ 9.0	129.5				

U. S. Crude Oil Production, by States (Thous. Bbls.)

STATE or DISTRICT	Daily Average for Month July 1961	July 1960	% Diff.	June 1961	Total, January-July 1961	1960	% Diff.
Alabama	19.4	21.2	— 8.5	19.3	4,250	4,695	— 9.5
Arkansas	75.2	78.8	— 4.6	77.3	17,189	19,103	— 10.0
California	817.4	834.2	— 2.0	820.3	174,972	203,042	— 13.8
Colorado	126.2	128.4	— 1.7	128.4	27,543	31,168	— 11.6
Florida	1.0	1.0		1.1	219	256	— 14.5
Illinois	209.9	213.4	— 1.7	213.6	45,371	52,615	— 13.8
Indiana	29.8	31.1	— 4.2	30.7	6,555	7,772	— 15.7
Kansas	303.5	303.5		304.8	65,573	75,157	— 12.8
Kentucky	50.9	56.0	— 9.1	50.8	10,893	14,617	— 25.5
Louisiana	1,125.6	1,049.2	+ 7.3	1,146.1	244,059	259,499	— 6.0
North Louisiana	114.4	127.5	— 10.3	110.8	26,464	30,628	— 13.6
South Louisiana	1,014.2	921.7	+ 10.0	1,035.3	217,595	228,871	— 4.9
Michigan	56.0	41.9	+ 33.7	53.8	11,467	7,964	+ 44.0
Mississippi	150.5	136.2	+ 10.5	149.9	31,702	30,035	+ 5.6
Mo.-So. Dak.-Tenn.	0.7	1.1	— 36.4	0.7	198	195	+ 1.5
Montana	84.8	84.0	+ 1.0	87.3	17,749	17,447	+ 1.7
Nebraska	61.4	71.0	— 13.5	68.3	14,383	13,857	+ 3.8
Nev.-Wash.-Alaska-Ariz.	19.4	1.1	+1,663.6	17.0	2,786	172	+1,519.8
New Mexico	294.3	291.3	+ 1.0	305.7	64,865	63,008	+ 2.9
Southeast New Mexico	255.4	246.0	+ 3.8	268.6	55,845	53,214	+ 4.9
Northwest New Mexico	38.9	45.3	— 14.1	37.1	9,020	9,794	— 7.9
New York-Pennsylvania	19.7	20.7	— 4.8	20.2	4,293	4,713	— 8.9
North Dakota	52.6	61.7	— 14.8	56.8	12,374	12,100	+ 2.3
Ohio	13.4	12.9	+ 3.9	12.0	2,824	2,903	— 2.7
Oklahoma	504.6	504.9	— 0.1	501.6	112,434	113,366	— 0.8
Texas	2,451.5	2,432.2	+ 0.8	2,476.7	549,634	551,347	— 0.3
Dist. 1: South Central	44.6	44.0	+ 1.4	45.9	9,822	9,399	+ 4.5
Dist. 2: Middle Gulf	105.1	105.3	— 0.2	107.0	23,987	24,626	— 2.6
Dist. 3: Upper Gulf	341.0	345.5	— 1.3	336.4	74,543	76,666	— 2.8
Dist. 4: Lower Gulf-S.W.	180.6	178.2	+ 1.3	187.4	40,523	40,266	+ 0.6
Dist. 5: East Central	27.6	26.5	+ 4.2	26.8	5,879	15,839	— 62.9
Dist. 6: Northeast	233.8	232.4	+ 0.6	241.6	53,292	52,957	+ 0.6
Dist. 7-B: North Central	123.5	126.4	— 2.3	121.4	26,818	27,626	— 2.9
Dist. 7-C: West Central	113.9	118.4	— 3.8	113.5	24,967	26,426	— 5.5
Dist. 8: West	1,003.1	955.7	+ 5.0	1,000.5	222,319	218,450	+ 1.8
Dist. 9: North	171.5	195.1	— 12.1	191.1	40,552	41,558	— 2.4
Dist. 10: Panhandle	106.7	107.8	— 1.0	105.0	22,324	23,122	— 3.5
Utah	84.2	95.0	— 11.4	93.2	19,631	22,400	— 12.4
Virginia					3	4	— 25.0
West Virginia	7.8	6.0	+ 30.0	6.9	1,464	1,305	+ 12.2
Wyoming	397.5	382.7	+ 3.9	392.0	85,051	75,379	+ 12.8
Total United States	6,957.3	6,859.5	+ 1.4	7,034.5	1,527,482	1,499,337	+ 1.9

Sources for above 3 tables: Bureau of Mines monthly reports except last two months based on API and B. of M. weekly reports and WORLD OIL estimates and Texas districts from API.

1959, rose 2.2 percent in 1960, and is expected to rise 1.6 percent in 1961.

Previously, there were some large annual increases in the post-war years. Demand jumped 10.7 percent in 1947, was up 4.1 percent in 1948, decreased 0.2 percent in the recession year 1949, recovered sharply by 11.1 percent in 1950, again jumped 9.7 percent in 1951, and then had gains of 3.2 percent in 1952, 3.8 percent in 1953, 1.4 percent in 1954, and again spurted in 1955 by 8.8 percent, before slowing to an annual gain of 4.3 percent in 1956.

Significantly, as long as the demand for petroleum was growing 4 to 11 percent per year, the industry did not have many serious difficulties of balancing supplies with demand, and markets and prices were rather consistently stable. But conversely, when demand faltered in 1957, so did the industry's markets and prices; and in subsequent years, limited growth in demand has been attended by unstable markets and prices.

In view of the continuing slower rates in growth of oil use, the industry must be resigned to an unceasing need to keep supply in balance with demand. It must keep constant watch over stocks of crude and products, and avoid surpluses by promptly readjusting refinery runs, crude production, and imports when necessary. When sales are increasing sharply, surpluses may be eliminated without great difficulty. But when consumption is growing slowly, the industry cannot depend on new customers to absorb its surpluses. If it overproduces and accumulates surpluses, the surpluses may remain and hang over the markets for a long time, awaiting better demand, which comes slowly.

For the first seven months of 1961, demand for gasoline was up 0.3 percent, the same as total demand for all oils. Distillate fuel oil demand was up 0.6 percent, but residual fuel oil demand was down 4.2 percent. Kerosine demand was strong, showing an increase of 8.7 percent. The demand for all other oils combined was up 2.3 percent.

Stocks of all oils July 31, 1961, totaled 830.3 million barrels, up 36.6 million barrels or 4.6 percent over one year previously. Crude and most products showed increases, but gasoline stocks of 193.5 million barrels were under the 196 million held a year earlier.

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A TEXAS INSTRUMENTS COMPANY

Drilling continues to improve

By World Oil Staff

THE MID-YEAR upturn in U.S. drilling activity continued through July. In fact, for the first time this year the July monthly statistics showed an increase over the same 1960 period in nearly every category.

Operators completed an average of 129 new wells daily during July, up 3.2 percent over the June average of 125 wells. Also, the July total of 4,005 new wells completed was up 108 wells or 2.7 percent over July 1960.

Footage drilled averaged 545,200 feet per day in July, up 2.2 percent over the 533,300 feet per day drilled during June—and 6.9 percent more than the 509,700 feet per day drilled during July 1960.

Operating rigs totaled 3,664 in July, up 183 rigs or 5.3 percent over the 3,481 rigs operating at June's end, and 7.6 percent greater than the 3,406 rigs reported operating on July 31, 1960.

New well completions reported during the first seven months of 1961 totaled 25,218, off 5.2 percent from the same 1960 period. The decrease would have been much greater had it not been for a 19.4 percent increase in gas well completions during the first seven months. During this same period, new oil well completions were off 6.3 percent from 1960, to 11,933 wells.

U.S. Drilling Activity in July and First Seven Months, 1961

STATE or DISTRICT	TOTAL NEW WELLS COMPLETED									WILDCATS COMPLETED						†Active Rigs End of Month
	July							January-July		July					Jan.-July Total	
	Oil	Dist.	Gas	Dry	Service	Total Wells	Total Footage	Total Wells	Total Footage	Oil	Dist.	Gas	Dry	Total Wells		
Alabama	1	....	....	....	....	1	11,519	30	332,756	....	....	....	....	....	5	4
Alaska	4	....	....	1	....	5	44,817	26	268,998	....	....	....	1	1	5	11
Arizona	....	....	....	1	....	1	6,515	11	25,416	....	....	....	1	1	7	2
Arkansas	13	....	5	20	1	39	160,430	282	1,067,141	....	....	....	4	4	50	36
California	88	....	7	48	2	145	664,728	958	4,282,794	....	....	1	23	24	155	127
Colorado	5	....	9	39	....	53	260,439	314	1,520,585	....	....	....	22	22	162	60
Illinois	80	....	....	117	....	197	411,790	956	2,096,299	1	....	....	61	62	265	262
Indiana	18	....	....	57	....	75	105,587	432	657,213	....	....	....	26	26	126	75
Kansas	183	....	31	214	25	453	1,605,329	2,742	9,797,290	10	....	1	73	84	430	246
Kentucky	69	....	21	87	2	179	157,103	1,247	951,577	2	....	....	5	7	34	153
Louisiana	163	16	36	130	....	345	2,428,728	2,082	15,747,868	2	....	1	51	54	298	335
North	72	....	27	61	....	160	476,603	830	2,733,761	1	....	....	21	22	133	82
South	91	16	9	69	....	185	1,952,125	1,252	13,014,107	1	....	1	30	32	165	253
*Gulf of Mexico	27	2	4	8	....	41	420,092	304	3,146,052	....	....	....	3	3	26	61
Michigan	16	....	13	30	....	59	185,217	373	1,224,177	1	....	2	19	22	143	112
Mississippi	19	....	9	32	....	60	618,847	317	3,190,411	....	....	....	19	19	92	60
Missouri	....	....	....	4	....	4	5,538	9	13,892	....	....	....	....	....	....	2
Montana	15	....	1	26	....	42	216,675	248	1,319,748	....	....	....	22	22	113	26
Nebraska	36	....	1	72	....	109	489,936	615	2,772,620	8	....	....	61	69	297	23
New Mexico	79	....	11	36	....	126	708,205	947	4,942,620	2	....	1	18	21	142	138
Southeast	67	....	3	28	....	98	566,115	604	3,245,643	2	....	1	13	16	113	75
Northwest	12	....	8	8	....	28	142,090	343	1,696,977	....	....	....	5	5	29	63
New York	6	....	7	9	17	39	72,375	214	367,500	....	....	....	....	....	....	25
North Dakota	14	....	....	15	....	29	193,524	146	895,090	....	....	....	8	8	35	17
Ohio	59	....	19	20	....	98	231,862	562	1,389,704	1	....	1	3	5	29	116
Oklahoma	205	8	37	117	39	406	1,430,703	2,728	10,061,219	2	....	6	14	22	226	589
Pennsylvania	19	....	20	5	19	63	153,113	334	889,668	....	....	1	1	2	20	68
South Dakota	....	....	....	1	....	1	8,819	4	23,500	....	....	....	1	1	4	1
Tennessee	....	....	1	14	....	15	15,827	59	42,945	....	....	....	11	11	30	10
Texas	678	18	144	401	19	1,260	5,945,295	8,330	37,940,580	22	3	8	217	250	1,740	903
District—																
1: South Central	27	....	3	31	....	61	181,544	463	1,311,223	....	....	1	22	23	156	51
2: Middle Gulf	27	....	29	31	....	87	530,454	481	3,206,330	1	....	4	22	27	156	84
3: Upper Gulf	48	15	10	34	1	108	703,699	705	4,713,117	1	1	1	14	17	164	72
*Gulf of Mexico	....	....	1	....	....	1	8,469	5	49,603	....	....	....	....	....	4	4
4: Lower Gulf-S.W.	28	....	26	53	....	107	676,617	788	4,253,124	....	....	1	33	34	196	135
5: East Central	7	....	4	10	....	21	141,801	145	905,794	....	....	....	9	9	76	21
6: Northeast	86	3	4	20	....	113	568,862	565	2,917,206	....	2	....	11	13	83	45
7-B: North Central	47	....	13	48	....	108	352,401	1,046	3,184,520	8	....	....	31	39	311	81
7-C: West Central	31	....	4	16	....	51	232,781	374	1,682,035	3	....	1	11	15	133	83
8: West	186	....	17	52	5	260	1,418,499	1,622	8,889,335	7	....	....	31	38	253	139
9: North	145	....	15	86	13	259	716,650	1,481	3,888,213	1	....	....	28	29	174	109
10: Panhandle	46	....	19	20	....	85	421,987	660	2,989,683	1	....	....	5	6	38	83
Utah	4	....	3	6	....	13	73,011	132	782,480	....	....	....	5	5	53	39
Washington	....	....	....	....	....	....	....	10	42,620	....	....	....	....	....	8	1
West Virginia	24	....	55	22	....	101	262,303	587	1,476,136	....	....	....	....	....	....	151
Wyoming	35	....	5	43	....	83	404,453	499	2,621,261	2	....	2	28	32	171	66
Others	....	....	....	4	....	4	16,019	24	124,623	....	....	....	3	3	15	6
Total U.S., July, 1961	1,833	42	435	1,571	124	4,005	16,888,707	25,218	106,868,731	53	3	24	697	777	4,655	3,664
June, 1961	1,749	30	369	1,489	107	3,744	15,966,617	....	....	53	2	23	630	708	....	3,481
July, 1960	1,798	53	379	1,565	101	3,896	15,814,613	26,602	111,069,879	63	4	28	722	817	5,319	3,406
Western Canada June, 1961	148	....	42	56	....	246	1,267,627	1,278	7,179,105	....	....	....	....	....	....	139
June, 1961	102	....	36	38	4	180	881,649	....	....	....	....	....	....	....	....	170
July, 1960	132	....	32	58	19	241	1,238,345	1,416	7,692,395	....	....	....	....	....	....	249

* Gulf of Mexico wells are included in their respective district totals. † Includes wells rigging up, drilling, and temporarily shut-down.

Originated by Cities Service, this 24,000-pound capacity truck speeds delivery of grease to industrial plants

Cities Service on the move

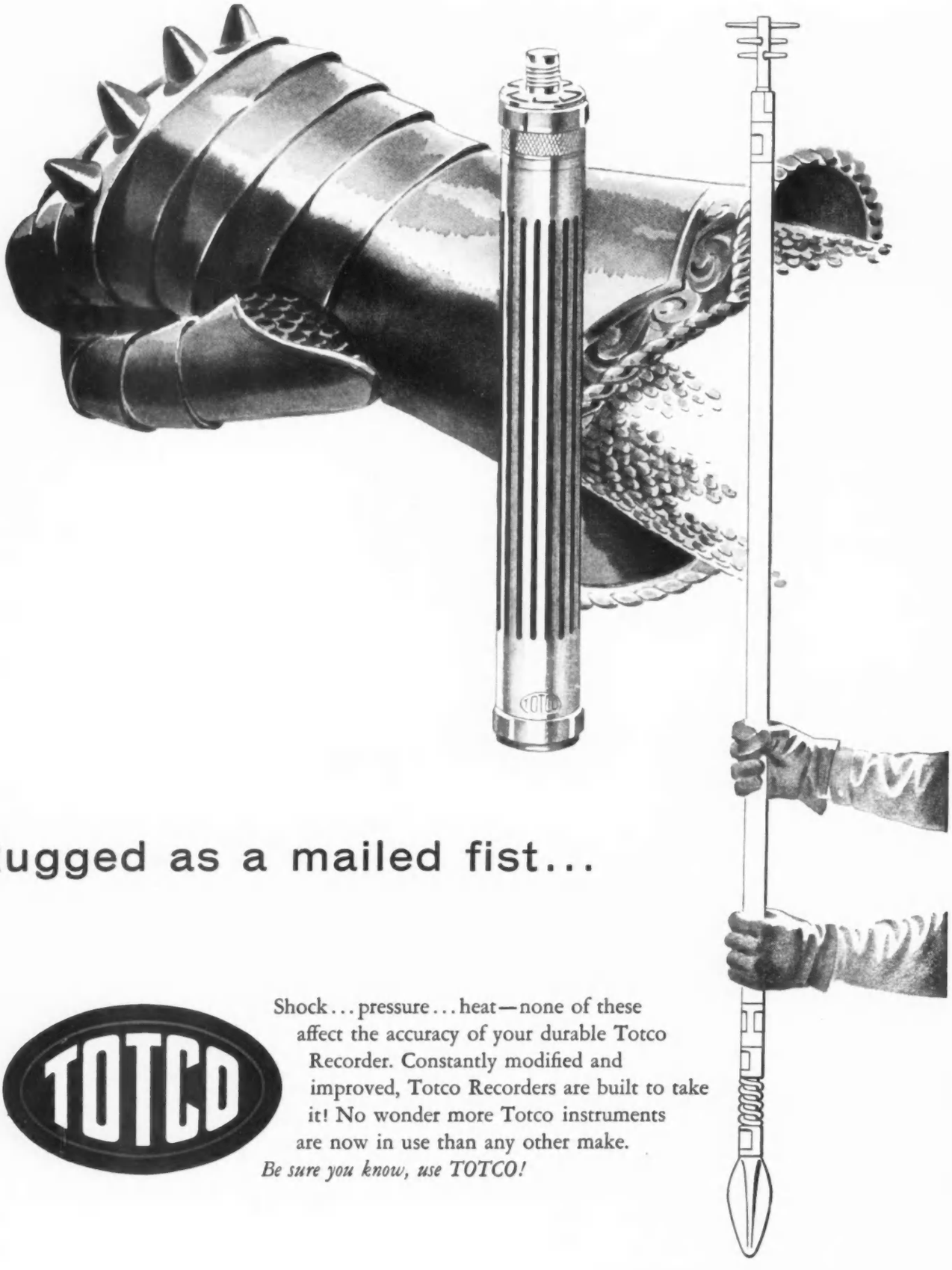
Faster . . . faster . . . faster! That must be the pace of American industry if it is to meet the challenge of the years ahead . . . but it will not be enough to do things at greater speed. They must also be done better than ever before.

Old blueprints will not serve. Cities Service has drawn new ones. They call for improved methods . . . new facilities where needed . . . intensified research . . . and the redeployment of manpower into streamlined organizational effort.

The impact of this drive for progress is being felt every day on a hundred fronts. In every area of its far-flung enterprise . . . from producing field right on through to your near-by service station . . . *Cities Service is on the move!*

"Keep your eyes on Cities Service"

CITIES SERVICE



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TOTCO

Shock... pressure... heat—none of these affect the accuracy of your durable Totco Recorder. Constantly modified and improved, Totco Recorders are built to take it! No wonder more Totco instruments are now in use than any other make.

Be sure you know, use TOTCO!

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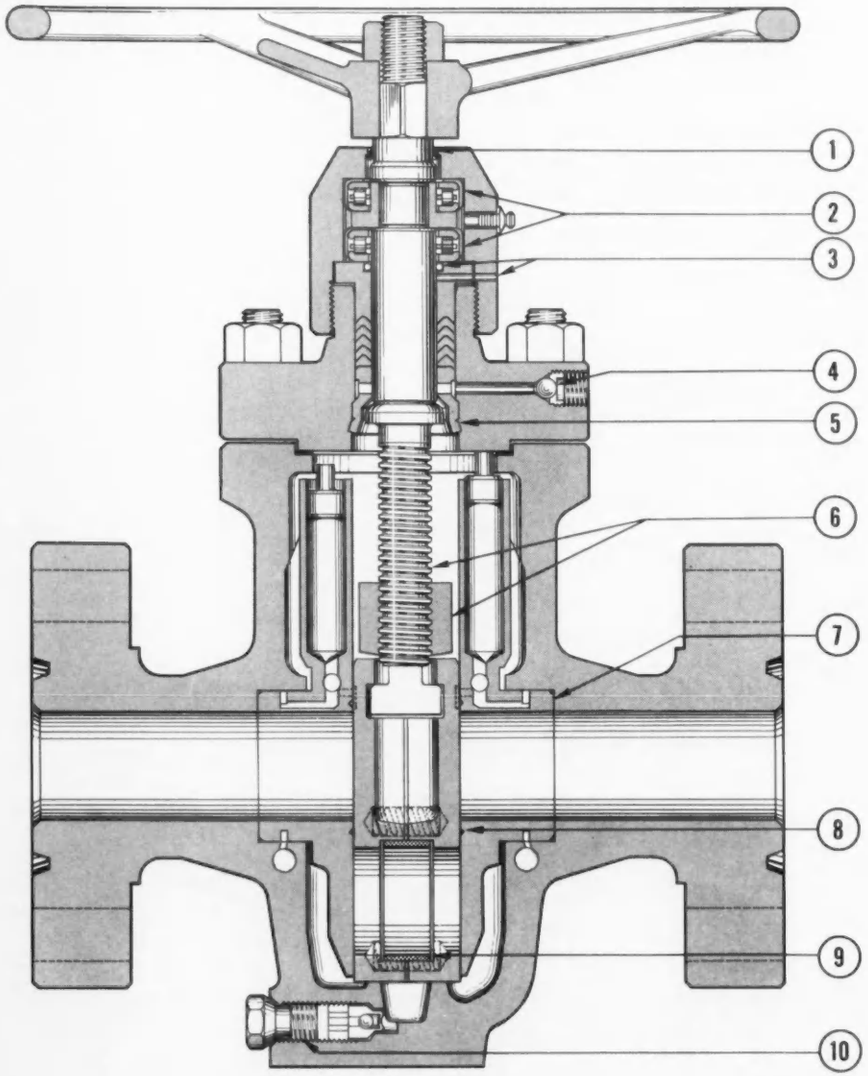
EXCLUSIVE DISTRIBUTORS: *California*—The Republic Supply Company of California; *Domestic*—The Continental-Emsco Company, a division of Youngstown Sheet & Tube Company; *Canada*—Oil Well Supply Division, United States Steel Corporation; *Export*—Lucey Export Corp., New York City

McEVOY'S NEW MODEL "C" GATE VALVES

McEVOY'S NEW MODEL "C" GATE VALVES



FIELD PROVEN CHANGES

1. New Bearing Grease Seal—seals *in* grease—seals *out* dirt and moisture.
2. New Roller Thrust Bearings—with *large* rollers, giving easier operation.
3. Bearing Protection Seal and Vented Bonnet Construction—prevents packing seepage from getting to bearings—bearings are "Sealed in Grease"—seepage bleeds to atmosphere.
4. New Spherical Bleeder Valve. For checking Stem Back-Sealing.
5. Replaceable Stem Guide and Backseat Bushing.
6. New Stem Thread and Lifting Nut design proven to give easier operation and longer life.
7. Field Replaceable Seats.
8. New Sealing Groove Contour effectively gives better self cleaning plus many more sealed-tight operations between low-cost servicings.
9. Resilient, Non-Wearing, Molded Trash Ring—keeps foreign material out of valve body and retains body filler (when desirable in valve body).
10. New Grease Connection—allows valve body to be filled with grease at any time valve is at least partially open.

IMPORTANT

Please observe that there have been NO CHANGES made in these three basic McEvoy principles.

- Dependable, proven, Automatic Self-Sealing (Gasketing)
- Two-Way Operation—Seals in EITHER direction. Can be reversed in the line for additional service.
- Safe, rugged, Bolted Bonnet Construction that has NEVER failed. (Designed to API Specifications)

All these major improvements—and a number of others—have been made in the new McEvoy Model "C" Valve—yet it costs you no more. It's smaller, more compact, yet it still retains its full opening bore. The Model "C" is available from stock in sizes 1⅜" through 8", and in working pressures from 500 lbs. WOG through 15,000 lbs. WOG. Other sizes and pressures are available on request. If you are concerned with valve performance and costs, then you should specify and use the new McEvoy Model "C" Gate Valves.

McEvoy **COMPANY / OIL WELL EQUIPMENT**

TEXAS AND MILBY STREETS • P. O. BOX 3127 • HOUSTON 1, TEXAS

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SUPPLY

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Jal-Con-Weld "50"
High Strength
High Performance
Low Price

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Why has Jal-Con-Weld "50", the original high strength welded macaroni tubing from Jones & Laughlin Supply Division gained wide acceptance in record time?

Because Jal-Con-Weld "50" offers a 50,000 pound psi minimum yield strength, yet is priced well below conventional high strength tubing.

Call your local J&L Supply man for all your macaroni tubing requirements, or write us at Tulsa, 1439 South Sheridan Road.

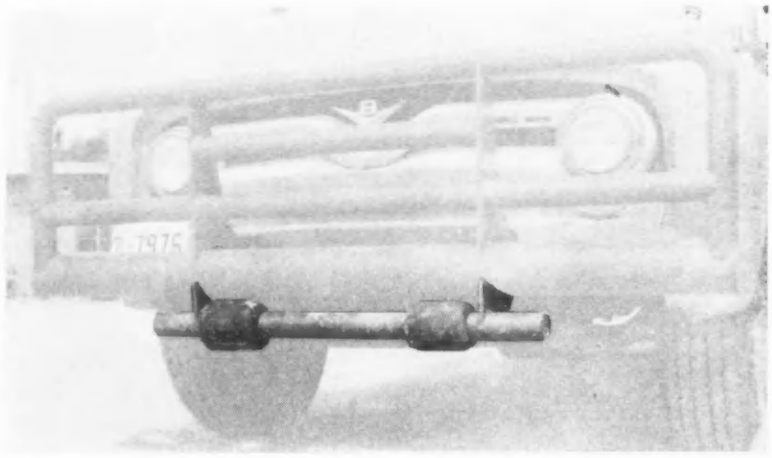
Jones & Laughlin Supply Division « Tulsa

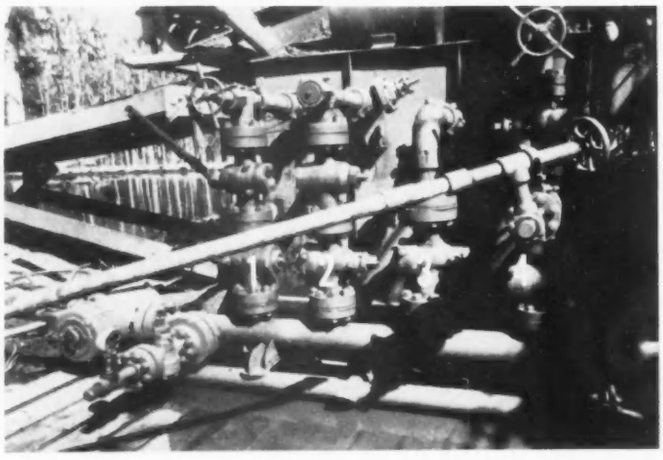
Practical operating hints

*These **How-To-Do-It** ideas can save you money*

Drill pipe protectors double as bumper guards

Misalignment of bumper when pushing cars with oil field equipment has caused unnecessary damage to the vehicle being pushed. An extra rung as shown is placed below the regular bumper guard. This rung is a 3-inch steel tubular rod equipped with worn out drill pipe protectors. It is relatively easy to rig up and still retain a neat appearing front end. The drill pipe protector is then the only part of the truck which comes in contact with the bumpers of the cars and the normal scratches that are usually encountered are minimized.



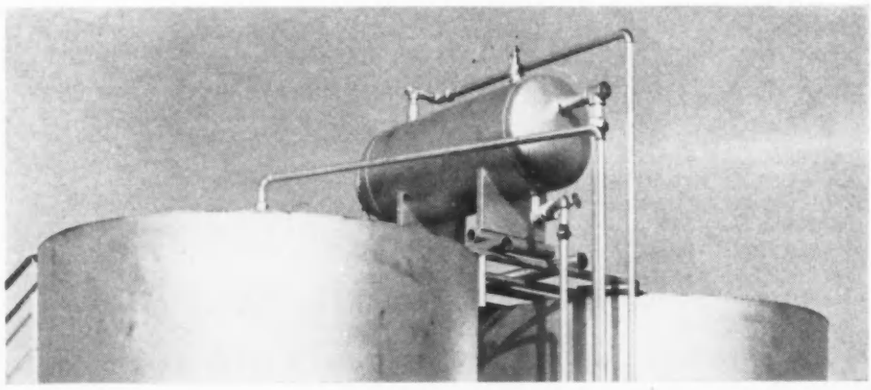


Mud tank doubles as drill stem test tank

The mud tank may be used as a DST test tank by placing a header at the end of the mud tanks and then running the drill stem tests directly into the mud tank. The header is placed on the line from the blowout preventer with the bottom line running on out to the reserve pit on the well and then each take off runs into the end of the tank. The first take off has an adjustable choke, the second a flow bean, the third is an open line and the fourth has a christmas tree arrangement whereby the production can be turned to the stock tanks or to the pit while the rig is being removed. The entire header assembly can be attached to the end of the mud tank during the drilling operations and testing may commence without a rig time interruption.

Use stock tanks for separator platforms

In most cases, steel platform structures are used to support elevated separators. However, an operator has saved cost of such an installation by setting the separator on top of the stock tanks. As shown, a supporting structure made of pipe has been welded between tanks. A field constructed separator skid, also of pipe, rests cross-wise on the tank structure.



C-7 C-7 C-7 C-7 C-8 C-8 C-8 C-8

C-7 C-7 C-7 C-8 C-8 C-8

SETTING NEW RECORDS

in drilling hard abrasive formations

- Conical shaped tungsten carbide inserts insure FASTER PENETRATION
- Flush tungsten carbide inserts insure FULL GAGE HOLE
- Threaded flow nozzles for easy installation
- Available for both fluid and air circulation

Smith TOOL CO.

A Division of SMITH INDUSTRIES International, Inc.

COMPTON, CALIFORNIA

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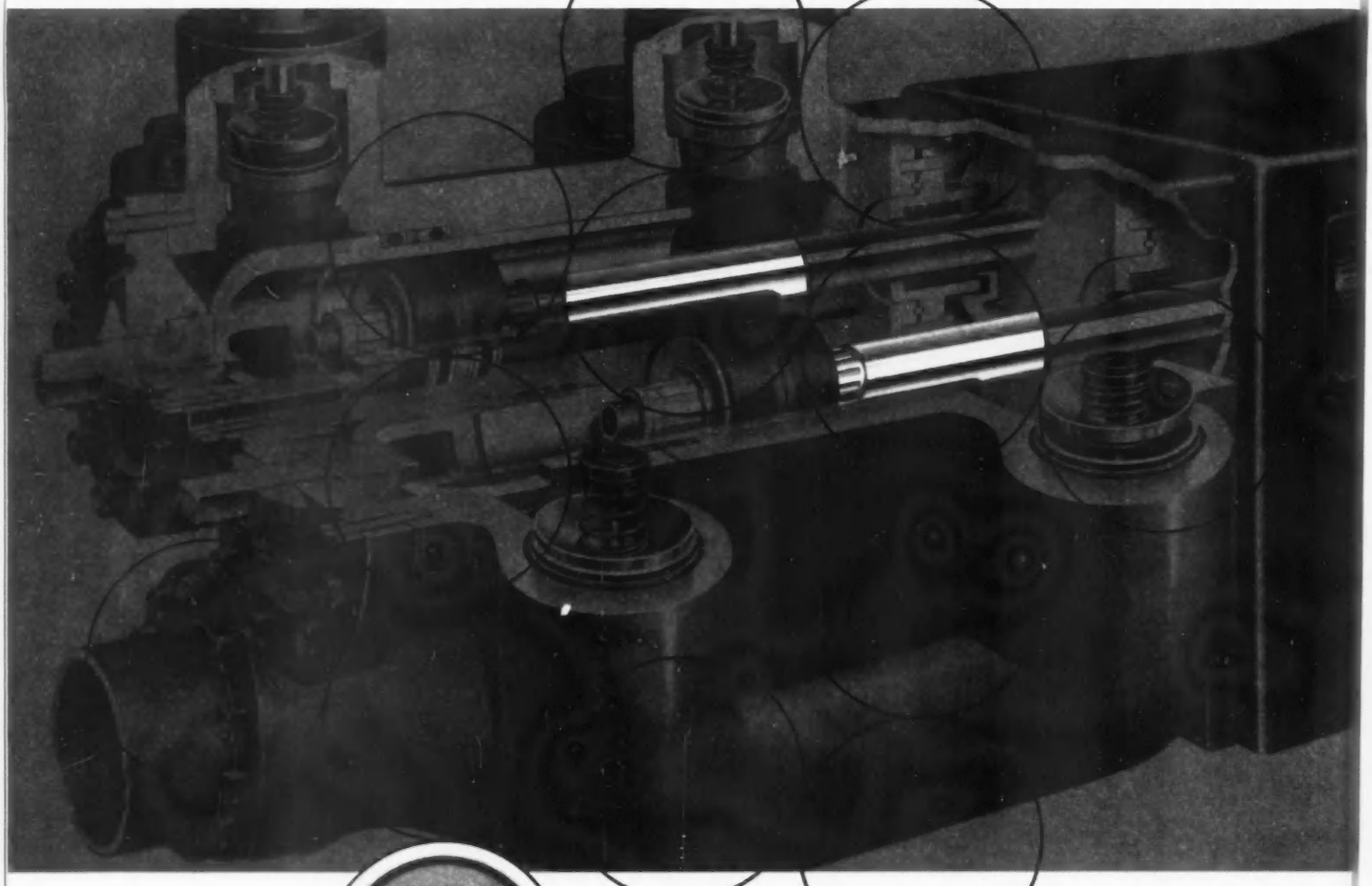
1936 OUR 25th YEAR 1961

Mission rods are here to stay



because Mission Super-Chrome rods have wearing surfaces

Ordinary rods must fight corrosion fatigue as well as the fatigue from tensile and compressive stresses. But, the tough, hard-chrome plating you see in the photograph protects Mission Super-Chrome® rods against corrosion fatigue. That's one more reason Mission rods last longer. Beneath the coat of heavy chrome you can see the deep, file-hard case. Inside is the tough, high strength core. Its unusually high ductility will resist the fatigue induced by literally millions of tension and compression cycles, while the chrome plating resists the corrosion fatigue which could be induced by millions of gallons of drilling fluid. Mission Super-Chrome rods are sure to stay in your pump longer than any others. Specify Mission parts all the way and save all the way.

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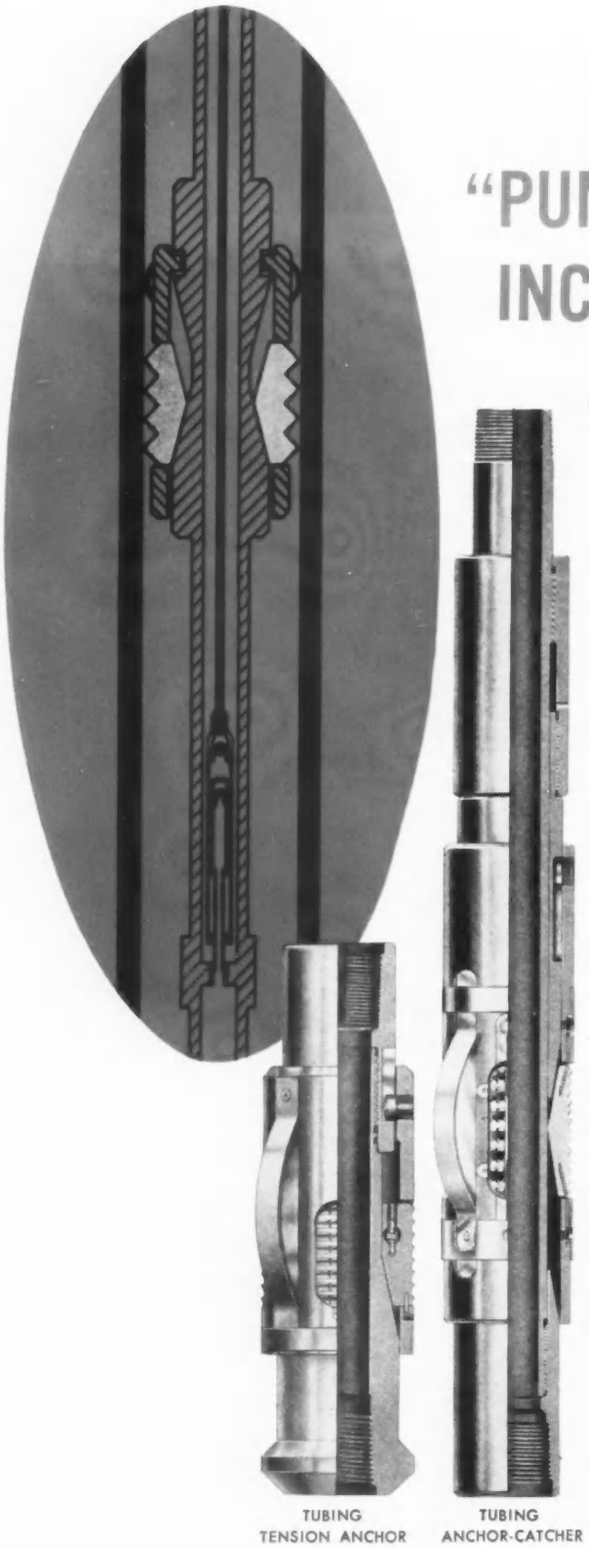
GALVESTON, TEXAS

132

"PUMPING EFFICIENCY INCREASED NEARLY 100%"



TUBING TENSION ANCHOR

TUBING ANCHOR-CATCHER

Major Company credits Halliburton Tubing Anchor-Catcher for these successful results:

"Ninety percent of the wells were using 2 in. tubing and pumping from 1,000 ft. to 1,500 ft. off bottom. On four different occasions our tubing parted while pumping and coming out of the hole, and the Tubing Anchor-Catcher prevented costly fishing jobs on each one. We have experienced less wear on our tubing and rods, and have found the corrosive resistant feature of this tool to be quite satisfactory."

The above is a statement of successful results attributed to Halliburton's Tubing Anchor-Catcher by a major oil company who, like many operators, have found that anchoring tubing in tension helps:

- Increase pump efficiency by reducing restrictions on plunger travel
- Reduces wear on rod and tubing couplings and threaded connections in the pump
- Increase pumping unit and rod life by reducing peak-torque reversal loads
- Reduces tubing stretch thereby lessening breathing and buckling of string.

ANCHORS TUBING IN TENSION AND CATCHES TUBING IF IT SHOULD PART

Made up in the string just above the pump, the Halliburton Tubing Anchor-Catcher offers the plus feature of catching the tubing by reverse action of the slips in the event it parts, thus helping to prevent a costly fishing job.

In the well, a ¼ turn of the tubing sets the tool's slips anchoring the string enabling it to be pulled into tension.

HALLIBURTON TUBING TENSION ANCHOR

This economical tool anchors the tubing providing the benefits of producing wells with tension anchored tubing as noted above. Setting tubing weight down automatically re-jays the tool and retracts the slips to pull the string.

SEE YOUR HALLIBURTON MAN for more information on these two advanced products. Specific details will be found in Brochure No. S-8031 . . . call today!

275 Service Centers

. . . Just minutes away

from your well!

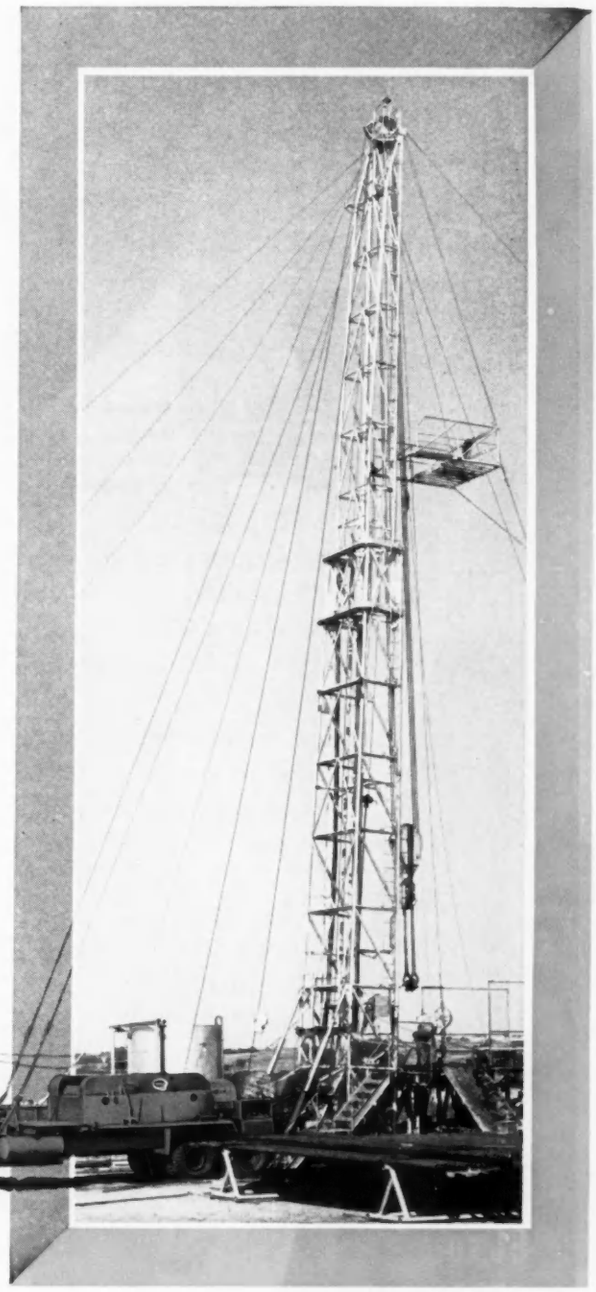
PRODUCTION TOOLS

Halliburton

COMPANY • DUNCAN, OKLAHOMA

Franks Explorer....

NOW FULLY FIELD PROVEN!



When the Franks Explorer was first introduced to the well servicing industry some two years ago it received immediate acceptance from many contractors. Others assumed a wait-and-see attitude. Why? Because the Explorer was a totally new concept — a self-propelled unit primarily designed as a servicing and workover rig, and mounted on a rugged carrier for secondarily designed to over the road travel. Here was the promise of new speed, more horsepower, greater flexibility. The "wait-and-see" groups settled back to watch.

AND WHAT DID THEY SEE?

Within two short years they saw the Franks Explorer outsell all competition. They saw themselves joining that first group of contractors who accepted the Explorer immediately — who knew Franks' reputation for building good equipment and for delivering what is promised.

If you're still from Missouri, ask the man who owns a Franks' Explorer. Or, better still, call your Franks' representative for all the details.

WELL SERVICING AND DRILLING UNITS

FRANKS

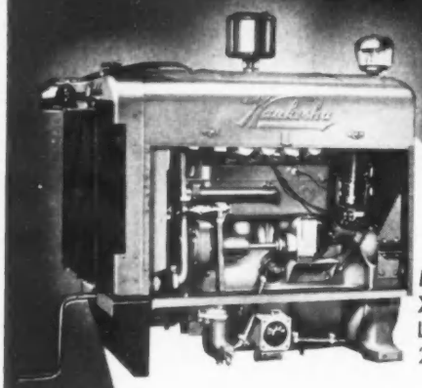
PAMPA, TEXAS

CABOT

CABOT CORPORATION
MACHINERY DIVISION

Worth more when you BUY 'EM . . . Worth more when you TRADE 'EM

You can't BEAT this EXPERIENCE



Model XAHU
Long Life Unit,
21 **continuous** hp

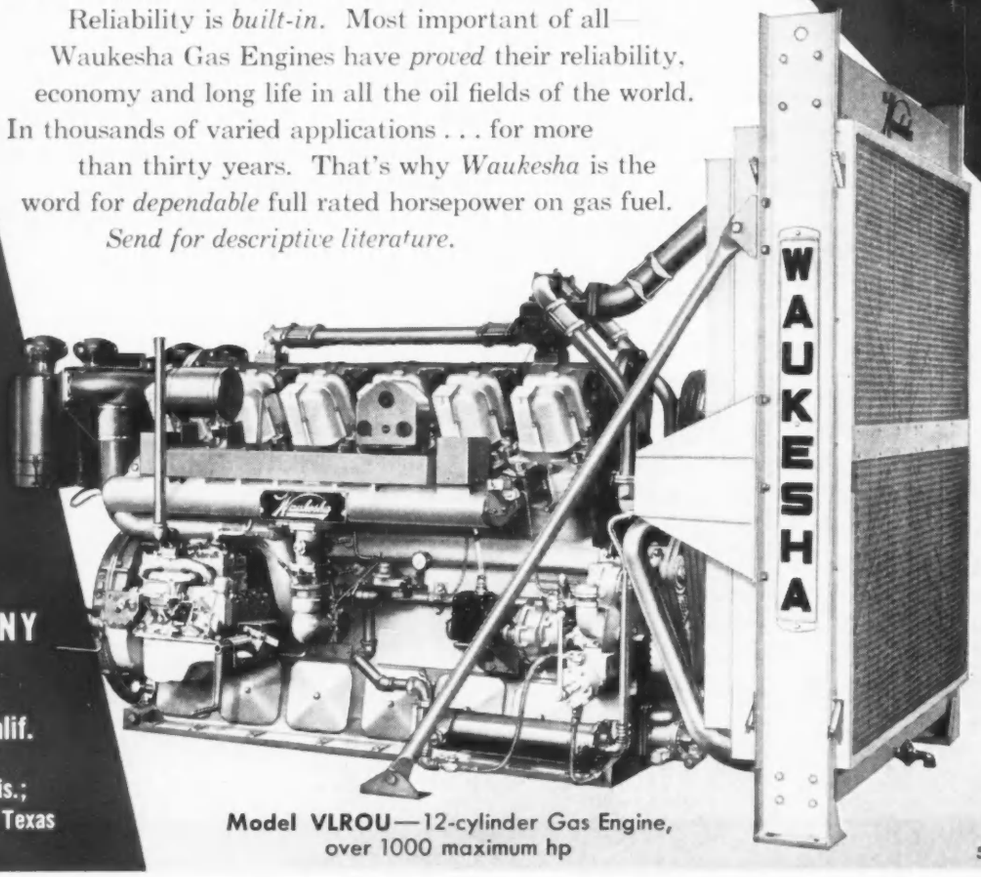
over 30 years proven top performance by WAUKESHA GAS ENGINES in the world's oil fields

It's easy to pick a gas engine that's really "tailor made" to your needs. Get a Waukesha *designed-for-gas* engine! Then you can be sure—before you buy. The Waukesha gas engine line is *complete*. You can get exactly the right engine. The Waukesha combination of *designed-for-gas*—and built-for-gas construction features, and first quality materials—that means low fuel and lubrication costs—is the result of Waukesha's over fifty years' experience in building fine engines. Reliability is *built-in*. Most important of all—Waukesha Gas Engines have *proved* their reliability, economy and long life in all the oil fields of the world. In thousands of varied applications . . . for more than thirty years. That's why *Waukesha* is the word for *dependable* full rated horsepower on gas fuel.

Send for descriptive literature.

10 to 1027 hp

61 to 5788 cu. in. displacement



Model **VLROU**—12-cylinder Gas Engine, over 1000 maximum hp

524

WAUKESHA MOTOR COMPANY

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NATIONAL ASSOCIATION, HOUSTON
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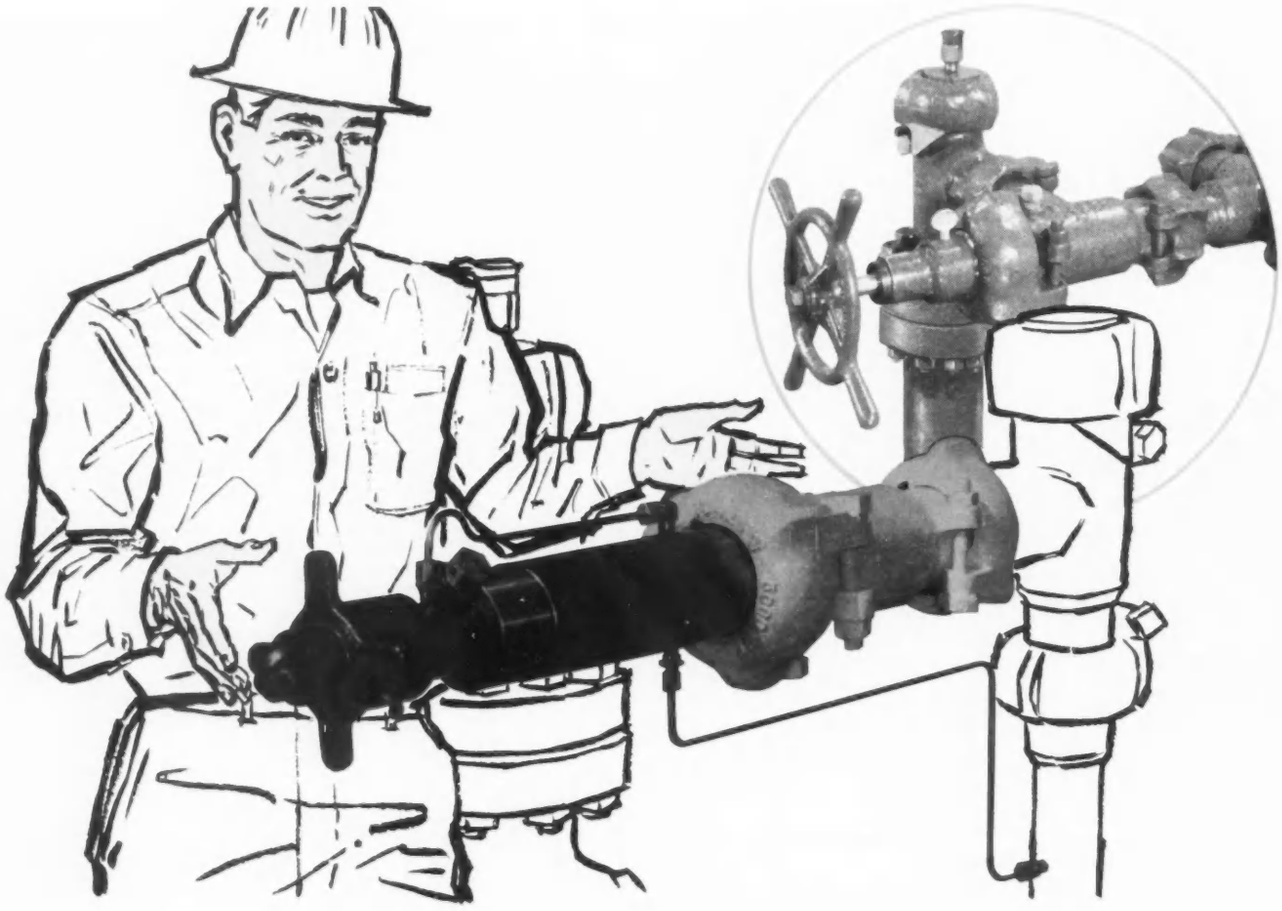
May we mail you our new brochure, "Business Success Begins at Bank of the Southwest"? It tells how our bank can help your company grow.



How to make the best Christmas tree a whole lot better

old trees: Convert your Unibolt Wing Valves to Unibolt Pressurematics by replacing the stem/bonnet assembly with the Pressurematic unit.

new trees: Specify Unibolt Pressurematic Wing Valves. They give you high/low safety plus a shut-off for choke changing.

Here is a valve that does the work of two valves yet costs little, if any, more than a good high pressure valve alone. It operates manually for choke changing, or automatically as a high-low safety valve.

The UNIBOLT PRESSUREMATIC VALVE combines all of the time-tested and proven features of the Unibolt Adjustable Wing Valve with a novel automatic actuating accessory. The valve closes instantly when a predetermined pressure balance across the seat is disturbed. The actuating mechanism consists of a small piston which is exposed to well pressure and a larger piston which is exposed to flowline pressure. A broken flowline or open valve, for example, in the production system, would lower the flowline pressure and thus instantly close the valve. Inversely, a rise in the flowline pressure, for any reason, would cause the valve to close.

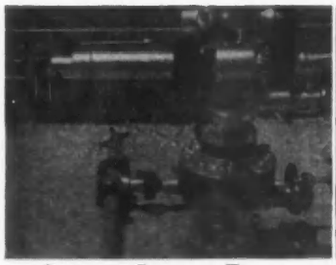
Once closed, the valve may be easily opened and set manually for automatic operation.

Send for literature or contact your nearest UNIBOLT sales representative.

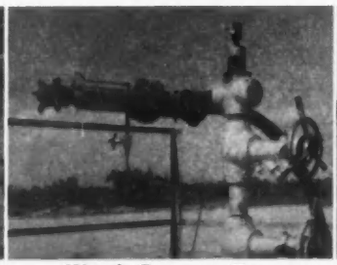
UNIBOLT

THORNHILL CRAVER CO.

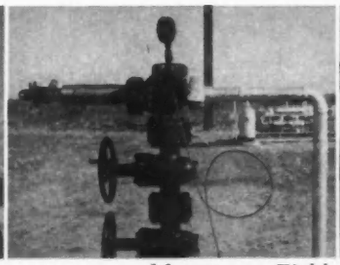
P. O. Box 1184, Houston, Texas

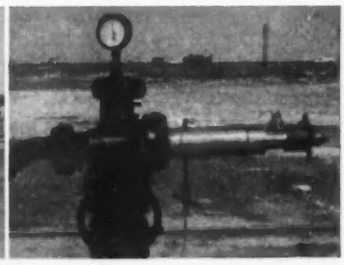


Reagan County, Texas



Ward County, Texas

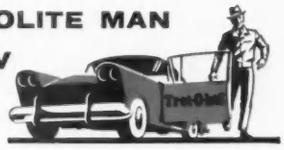




Monument Field, New Mexico

More salable oil results from an adequate treating program

LET YOUR TRETOLITE MAN SHOW YOU HOW



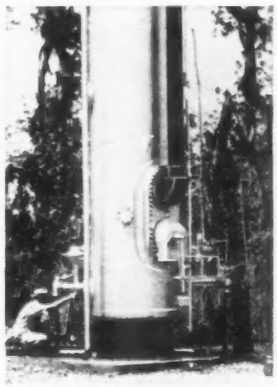
another
TRETOLITE SERVICE
report

Your TRETOLITE field service engineer is always on call . . . always ready to help you. He will gladly survey your treating operation for maximum efficiency.

Here are some important treating factors he will check:

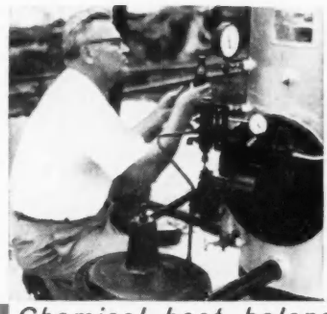
1 ***Treating chemical***

Is it the best for your operation?
Your TRETOLITE engineer will make tests and make sure.



2 ***Mechanical operations***

A faulty pump, a damaged valve, and many other mechanical factors can affect the severity of emulsification. Your TRETOLITE engineer will consult with you on such possibilities.



3 ***Chemical-heat balance***

Sometimes a little more chemical or a more efficient chemical can be used to reduce heating. The use of less heat can cut vapor losses which reduce gravity. Often a few degrees gain in gravity can earn a better selling price. Your TRETOLITE engineer will be glad to check this phase of your operation for you.

4 ***Chemical pump-chemical reservoir.*** Chemical pump malfunction or improper chemical pump location can cause trouble; so can a dirty chemical supply tank. Your TRETOLITE field service engineer will go over your chemical feed procedure and equipment —carefully, knowingly.

TF-60-2

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CORPORATION

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TRETOLITE COMPANY
DIVISIONS
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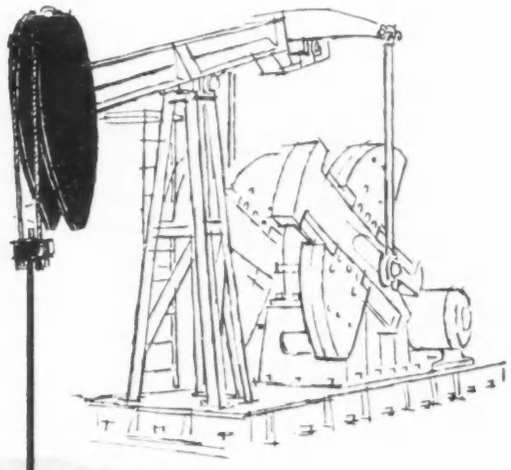
Order your sucker rods from these Bethlehem depots



Strategically located throughout the oil fields, Bethlehem's sucker rod depots assure prompt deliveries to all sections of the Mid-Continent and West Coast oil-producing areas.

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4 TYPES OF RODS FOR ANY PUMPING NEED

46, average tensile strength.....	90,000 psi
X Mayari, average tensile strength..	95,000 psi
X2, average tensile strength.....	100,000 psi
41, average tensile strength.....	130,000 psi

Among these types you will find the best rod to meet the particular requirements of your well.

Steel — *for Strength ... Versatility ... Economy*

For more information call any of the seven offices shown above, or write to us at Bethlehem, Pa.

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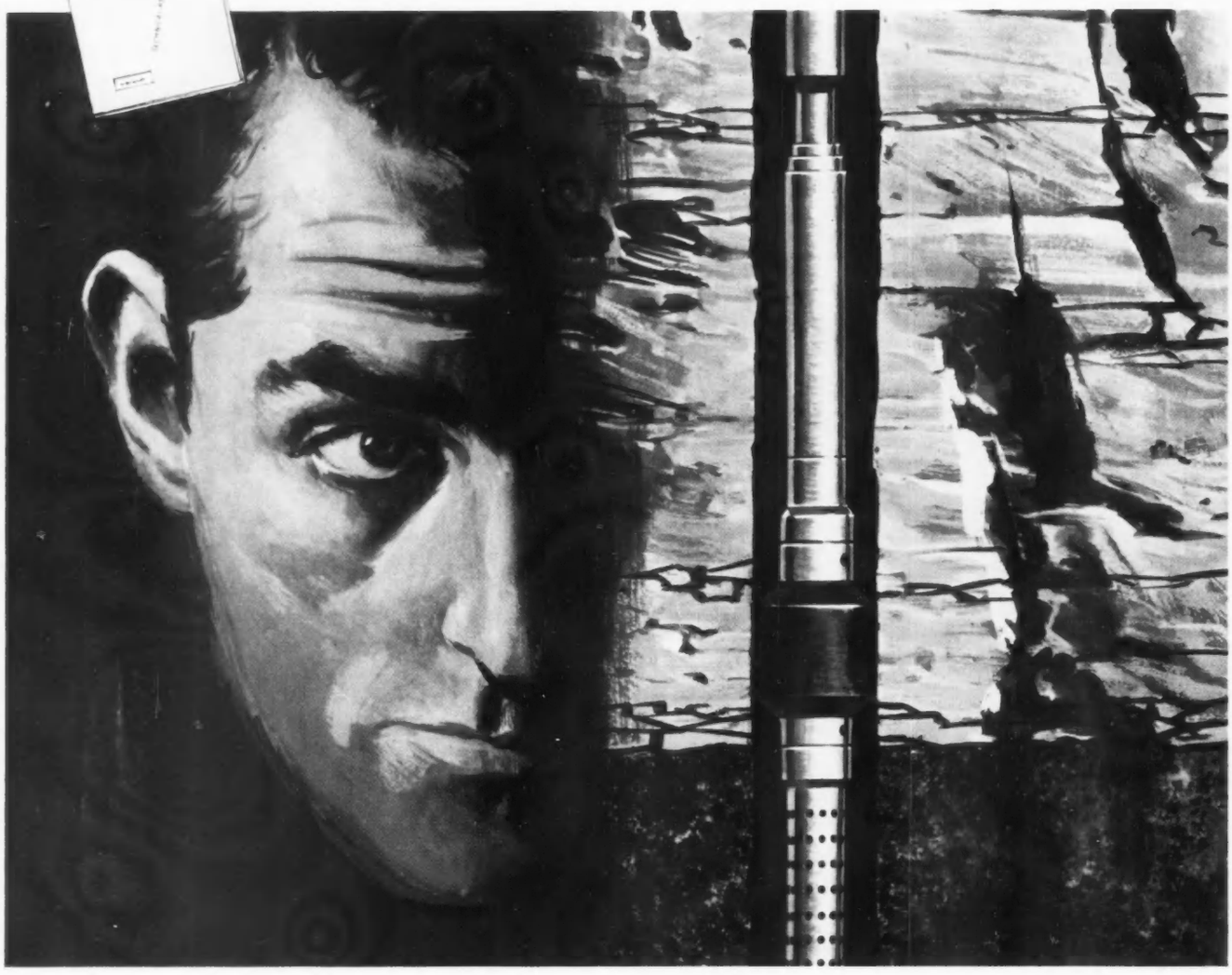

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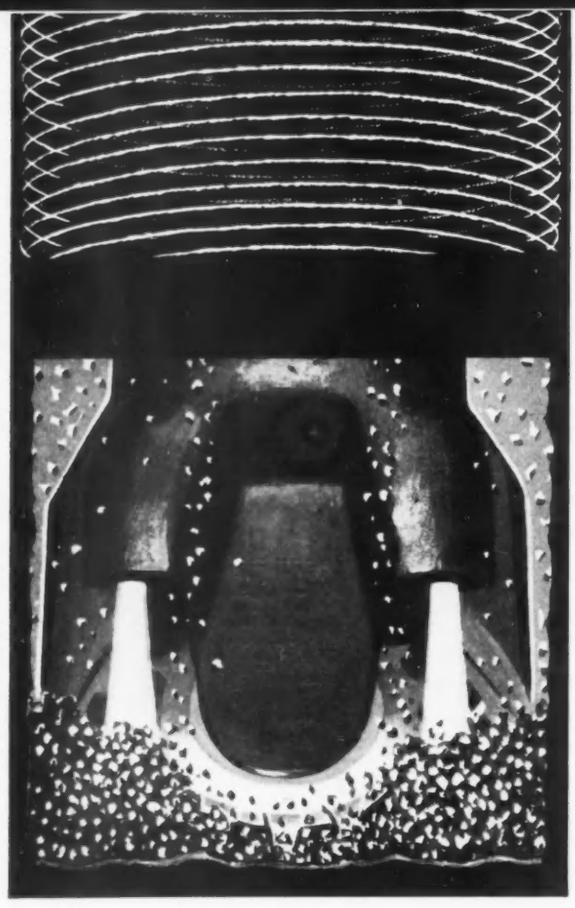
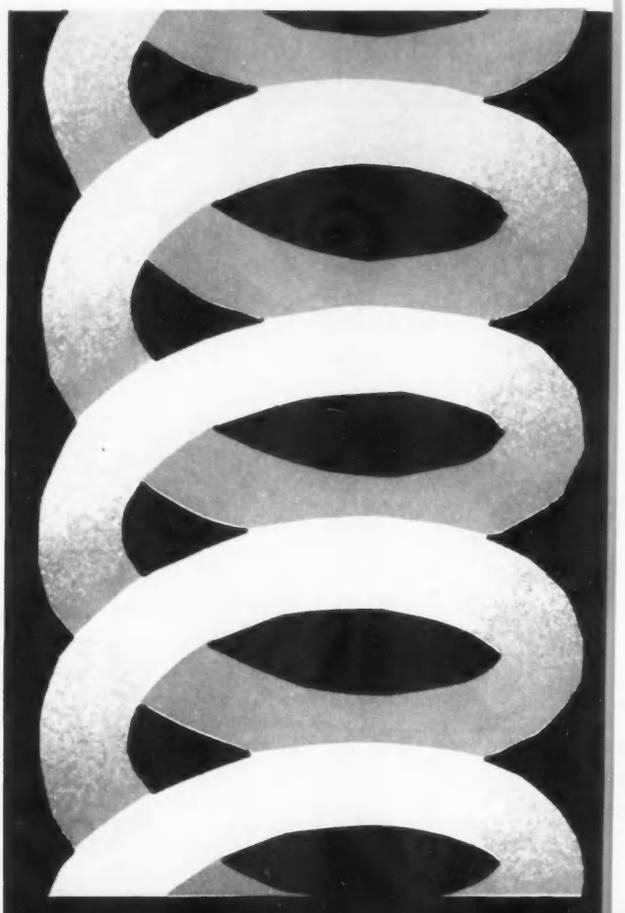
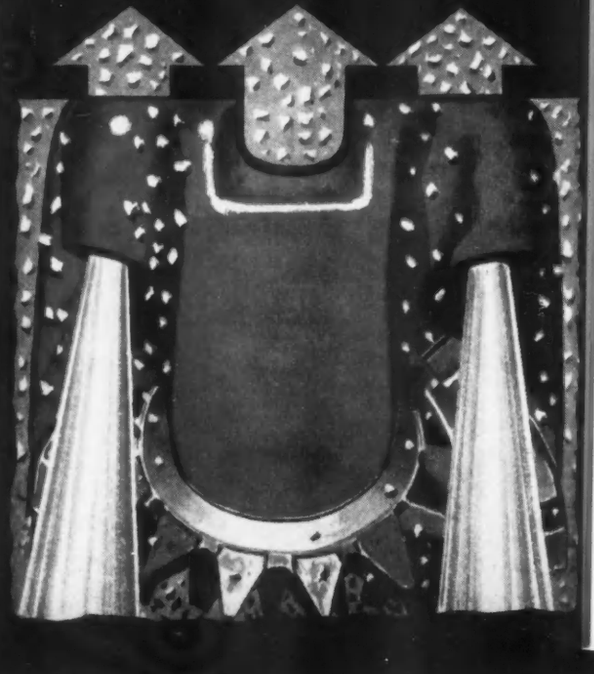


milling or drilling?





How can you tell if you're milling or drilling? It's easy. If you are using Reed Flush-Flo jet bits you **know** you're drilling ahead. Here's why—

1—The Flush-Flo ports allow an alternate route around the high velocity jets. Laboratory tests prove the Flush-Flo design allows the drilling fluid to sweep the entire bottom of the hole, whereas other jet type bits develop little fluid movement at the center.

2—Jet bits without Flush-Flo ports require all cuttings and circulating fluid to return past the high velocity discharge jets. Flush-Flo design provides up to 50% more return area, prevents re-circulating of cuttings, balling and re-drilling cuttings.

3—The Flush-Flo ports minimize hydrostatic pressure on the formation when running in the hole and minimize swabbing when pulling the string. These two factors afford maximum protection and minimum mud bills when drilling in lost circulation areas and leave wall cake and walls in better condition.

4—The flow pattern of the Flush-Flo jet bit provides less turbulence at the bit and affords greater protection in very soft formations.

The Flush-Flo design is an exclusive from the Reed research team—the most significant development since the advent of jet bits. The place to look for progress in drilling tools is right here at REED.

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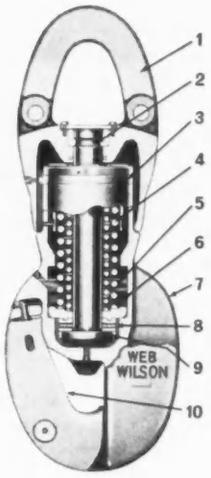

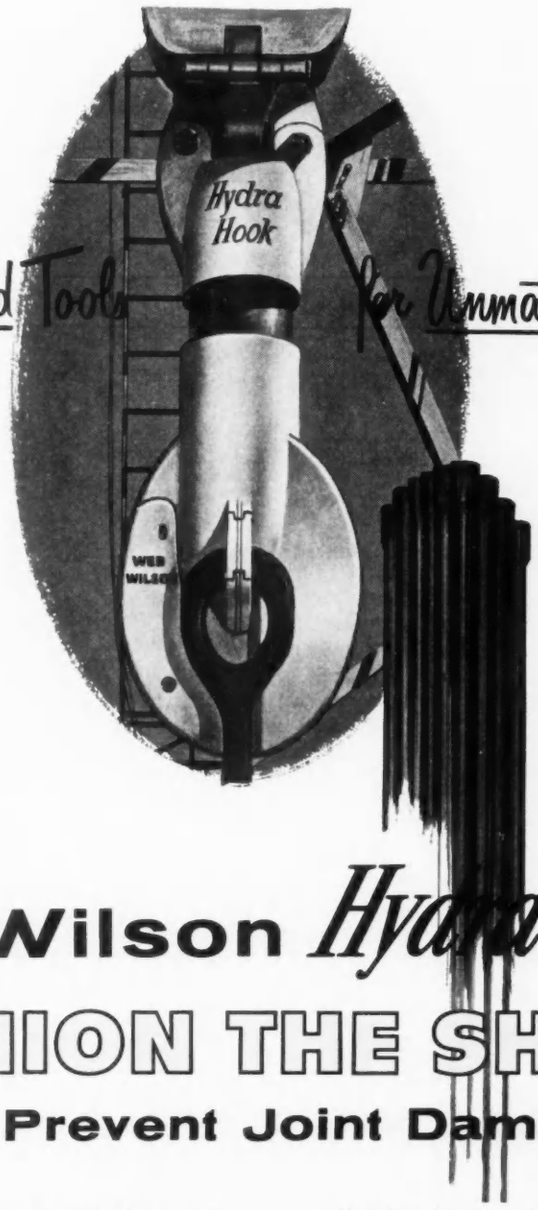

Web Wilson *Hydra Hooks*

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to Prevent Joint Damage

Every time a joint is made up or broken out, you benefit from the simple, foolproof shock absorbing hydraulic action of the Web Wilson Hydra Hook that prevents damage to threads and shoulders. Another distinct advantage—Hydra Hook is the shortest on the market—the least expensive way to add feet and inches of working height.

Economical operation and simple servicing are assured by these features: (1) Can be unitized or direct connected to all leading traveling blocks • (2) No load carrying threads—solid shank carries load • (3) 8 locked positions (12 in 450 ton) prevent rotation • (4) Less than 10 working parts • (5) Transported without draining oil • (6) Major internal parts enclosed in oil bath • (7) Parts are magnaflux inspected • (8) Large, staggered roller bearing, in oil bath for free swiveling • (9) No seals in hydraulic reservoir to leak • (10) Latch *cannot* open with load applied.

The WW Hydra Hook is another of the tools in the Baash-Ross line of "*Matched* Tools for *Unmatched* Performance" to speed operations at reduced expense.

See a Baash-Ross representative or the Composite Catalog for additional details.

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OTIS Equipment NEWS

Volume III, Number 4 Otis Engineering Corporation • Dallas *Production Equipment and Services*

New Low Pressure Pilot System Offers Simplified Multi-Point Protection In Surface Safety Valve Installations

DALLAS—Two new Otis Pilots have been developed that make possible a well safety system that includes: (1) Multi-point protection utilizing a low pressure control line and (2) Single point, single step resetting to place the entire system back in service after a shut-in. The two new pilots are the Type N Otis Actuator Pilot and the Type P Otis Hi-Lo Auto-Reset Pilot. Both can be used with any one of several different Otis Surface Safety Valves.

A Type N and P Otis Pilot System, when combined with the proper Otis Surface Safety Valves, may be installed to protect a single well or a number of wells such as may be located on an offshore platform. The simplest installation is where a low pressure line connects the Type P Pilots at the point where protection is desired and the Type N Pilot on the safety valve. With this type of hook-up pressure changes from the flow line, sales line, heaters, separators, etc. are automatically transmitted from the Type P pilot to the Type N Pilot and Safety Valve.

Evidence of the acceptability of the new Type N and P Otis Low Pressure Pilot System within the various levels of field operating personnel, from superintendents and engineers through pumpers and gaugers, is indicated by the large number of installations made during the short time the equipment has been available.

Application

The application of the Type N and P Otis Pilot System is practically unlimited — from a single well, simple line pressure installation to a complex, multiple well installation that requires a number of protection points for various conditions that could cause serious loss.

Basically the Type N and P Otis Low Pressure Pilot System is designed to monitor pressure increases or decreases at such points in a surface safety installation as line pressure, separator, LTX unit, free water knockout, heat exchanger and other field processing or production equipment. The system may be installed to monitor various other conditions, also, such as liquid levels, high or low temperatures, volume, viscosity, etc. Electrical control of the system — radio, direct wire or microwave — can be added through the use of solenoids and other electrical equipment. A typical installation, in schematic form, is below.

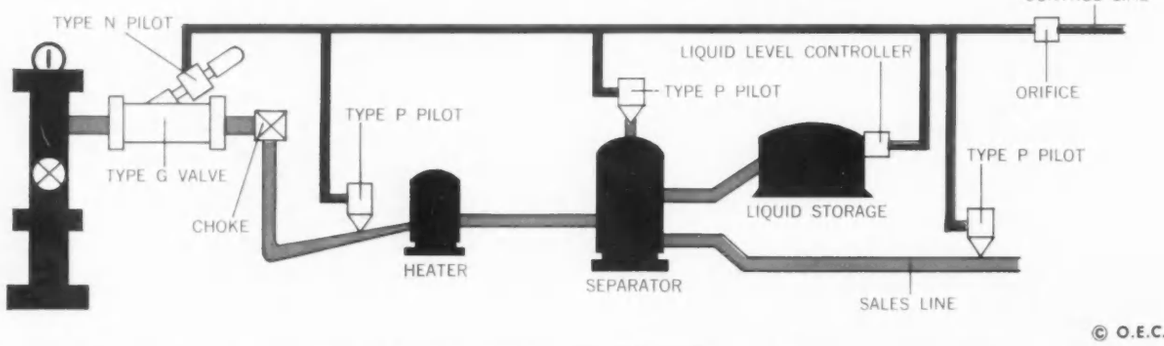
Here are several of the System's Feature Design Principles —

Low Pressure Control Line

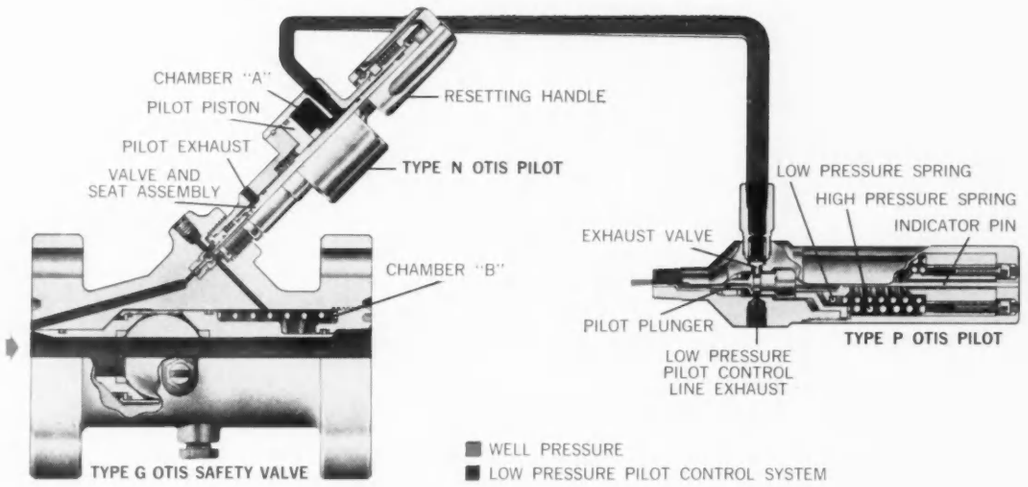
The Type N and P Otis Safety System is designed around the use of a low pressure (usually 30-60 p.s.i.) control line that connects the Type P Monitor Pilots with the Type N Actuator Pilot attached to the safety valve. The use of the low pressure line all but eliminates the possibility of hydrates forming and freezing the line — increasing the reliability of the safety installation. When a shut-in occurs, only one high pressure exhaust takes place . . at the safety valve. Choice of source pressure for the control line is optional — pressure is usually taken from the separator or furnished by bottled gas.

The system, in simplified form, monitors pressure changes through the Type P Otis Hi-Lo Auto-Reset Pilot. Pressure fluctuations beyond the preset limitation of the Type P Pilot cause the pressure on the control line to exhaust. Upon exhaust of the control line pressure, the pressure behind the piston of the Type N Otis Actuator Pilot is removed, allowing the pilot to exhaust a pressure chamber in the safety valve. This action serves to create a pressure differential in the safety valve and permits the line pressure to close the valve.

Installation Schematic of Typical GNP System



Operating Design Principle of Type GNP System



Illustrated as an example of a Type N and P Safety System is the Otis Type G Valve combined with the Type N and P Pilots. This combination of Otis equipment constitutes a safety system suitable for sensing pressure changes from a wide range of remote points. Although the Type G Otis Surface Safety Valve is used for illustration, the pilots may be used with other Otis Surface Safety Valves.

The Type P Pilot serves to monitor pressure fluctuations (within predetermined limits) in the flow line and/or other lines. Pressure variations, either too high or too low, cause the exhaust valve in the Type P Pilot to unseat and release the constant pressure on the connecting low pressure control line. When pressure is released from the control line, the low pressure on top of the piston in the Type N Pilot (Chamber A) is released and the piston moves back, allowing a ball to seat in the bypass of the Type G Valve. With the bypass sealed, pressure from Chamber B in the safety valve is exhausted through the pilot, creating a pressure differential across the ball and flow line pressure may then rotate the ball to the closed position. The entire system may be reopened merely by turning the resetting handle on the Type N Otis Pilot since the Type P Otis Pilot is designed to reopen automatically when pressures return to normal.

Single Point, One Step Reopening

The entire Type N and P Otis Pilot System is designed to be placed back in service after a shut-in by resetting the Type N Otis Pilot on the safety valve. The operation of the system is controlled from this one point . . there are no complicated procedures or detailed resetting instructions to follow. Merely turn the resetting handle on the pilot in as far as it will go and then back it out. The Type N Pilot also may be used to lock a safety valve installation out-of-service with the safety valve in the open position.

Design Principles of The Type N and P Otis Pilots

The adaptability of the Type N and P Low Pressure Pilot System comes from the flexible design principles incorporated into the two pilots . . Type N Otis Actuator Pilot and Type P Otis Hi-Lo Auto-Reset Pilot. As the name implies, the Type N is an actuator pilot for use on Otis Surface Safety Valves. The pilot does not monitor pressure changes, but acts only as a means for closing and opening the safety valve.

Well pressure is exposed to only a small portion of the pilot's valve plunger area. The internal springs, piston and other working parts of the pilot are normally never exposed to well fluids.

The standard Type N Pilot requires manual resetting. It may be modified for automatic resetting. The Type N Pilot is regularly supplied in a 150:1 operating ratio and installation records show a minimum of maintenance.

Type P Otis Hi-Lo Auto-Reset Pilot is a combination high and low pressure sensing device (0 to 10,000 p.s.i. range). It may be installed at any point in a surface safety valve system where protection is desired. The Type P Pilot does not require manual resetting after a shut-in but is designed to reset itself when the pressure it is monitoring moves back into the range of its settings.

A small pin at the rear of the pilot indicates whether the pilot is set and "in-service" or whether it has operated. Pressure from the monitored source enters in only a small portion of the ½" threaded male connection. Fluids that could corrode or damage the internal working assembly do not enter the main body area of the pilot.

For more details on the construction and operation of the pilot, see illustrations above.

Safety Equipment Recommendations

The Type N and P Otis Pilots are excellent examples of Otis' leadership in safety equipment. Experienced and trained Otis Safety Equipment Specialists have the combined knowledge of the company's more than 20 years experience to draw on when making installation recommendations. Whatever your safety equipment requirements, call the Otis office nearest you or write Otis, Dept. E-4, P. O. Box 35206, Dallas 35, Texas. You'll find Otis Safety Valve Specialists ready to help you . . anxious to serve you . . with the widest variety of production equipment and services available today.

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Retarded Acid Gets Results in Problem Wells

This table shows some of the recent results of Retarded Acid treatments performed by Dowell on problem wells in many areas. We hope it gives you some ideas that will result in greater profits from your wells.

LOCATION	NAME OF FORMATION	AMOUNT OF RETARDED ACID	RESULTS
Albert, Canada	Slave Point Mid Devonian Vugular lime	4000 gallons (acid-oil-emulsion type)	Production from old well went from 0 to 218 bopd.
Franklin County, East Texas	Limestone	30,000 gallons	16-fold gas production increase—from 400 mcfd to 6400 mcfd.
San Juan County, Utah	Paradox (Desert Creek Zone)	75,000 gallons (acid-oil-emulsion type)	Production boost from old well was 34 to 450 bopd in field where regular acid treatments are usually unsuccessful.
Ellis County, Kansas	Kansas City Lansing	2000 gallons (acid-oil-emulsion type)	Production nearly three times that of offset wells. $881 treatment cost paid out in 19 days.
Andrews County, West Texas	Pennsylvanian	10,000 gallons (acid-oil-emulsion type)	Production from old well boosted from 10 bopd to 60 bopd stabilized. This 50 bopd increase was made in a field where offset wells treated with 10,000 gallons regular acid usually yield an uneconomical 5 bopd increase.
Logan County, West Virginia	Big lime	4000 gallons	Production increased 100-fold to one million cfpd. Treatment cost paid out in two weeks. Entire well cost paid out in less than five months.
Lea County, New Mexico	Wolfcamp lime	3000 gallons (regular type) 15,000 gallons (acid-oil-emulsion type)	Well tested 275 bopd flowing. Other wells in field, given regular acid treatments, do not usually respond properly.
San Juan County, Utah	Paradox	40,000 gallons	Decline rate was reduced by treatment. Production was increased from 200 bopd to 700 bopd. Six months later production was still 700 bopd.
Alberta, Canada	D2	5000 gallons	Production from eight-year-old well had declined to zero with fluid level only 65 feet. One month after treatment, production had leveled off at 100 bopd, flowing.
Russell County, Kansas	Kansas City limestone	3000 gallons	Production boosted from 3 bopd to nearly 2000 bopd on test after clean-up.
McKenzie County, North Dakota	Madison lime	7000 gallons (acid-oil-emulsion type)	Production from old well increased from 35 bopd to 133 bopd after treatment. $3101.00 treatment paid out in 23 days.
Harrison County, East Texas	Pettit Oolitic lime	7000 gallons	Treatment of six-foot pay resulted in 40 mmcfd well with 60 barrels petroleum liquids per million.
Wabash County, Illinois	O'Hara lime (Highly soluble)	3000 gallons (acid-oil-emulsion type)	Well production stabilized at 75 bopd and treatment cost paid out in ten days. Regular acid had given poor results on nearby wells.
Fremont County, Wyoming	Embar lime	5000 gallons (acid-oil-emulsion type)	21 boph test from a pay that had been acidized and abandoned several years before. This treatment saved a well that would have been plugged otherwise.

Almost without exception, these treatments employed other Dowell products and services in addition to Retarded Acid. Most of the more recent treatments listed here were designed by Dowell engineers with the aid of the Acid Guide* – a method developed by Dowell for use in engineering acid treatments to get optimum results.

Take full advantage of Dowell's long experience, proved additives, and engineering ability. Call Dowell to perform your next acidizing treatment. Dowell services and products are offered from more than 150 offices and stations in the United States, Canada, Venezuela, Argentina, Germany, France and the Sahara area. Dowell, Tulsa 1, Oklahoma.

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—Texas well servicing company

"We Gave it the Acid Test . . ."
"Where acid was being used in our wells, plastic core, Union cable tool drilling line outlasted other brands. We also use Union Sand Lines with plastic core and they are doing an outstanding job."

—Illinois tool pusher

It Pays to Listen

Here's what they say about UNION'S UNI-CORE® cable tool and well servicing lines

New steels are born at Armco

UNI-CORE Service Line
Photo of a section of UNI-CORE Sand Line showing plastic core. Engineered to resist heat, acids—other enemies of long core life.

UNI-CORE Cable Tool Line
Developed to give the same outstanding performance in cable tool drilling as Union's UNI-CORE well servicing line.

"Rough duty since Dec., 1960 . . ."
"We gave UNI-CORE the works in servicing wells 10,000 feet and deeper. We check the line constantly. It has shown no breaks and has not pulled down in any place. No other make has given us such service."

—Oklahoma well servicing company

"We get better wear . . .
out of our UNI-CORE Sand Lines than any we have ever used. We bought Union cable tool line on the basis of our sand line service."

—W. Va. tool pusher

Here's first-hand proof from the field. Read what the tool pushers and the oil well servicing people themselves think of UNI-CORE.

They're getting greatly lengthened service, less down time and saving money through safe, efficient wire rope performance.

UNI-CORE Sand Line is the wire rope with the plastic core instead of fibre or wire. It is designed for the special needs of oil well servicing. It has superior resistance to compression, elongation, heat, acids and salt water — the natural enemies of long wire rope life. Cable tool pushers are getting the same superior service from UNION'S UNI-CORE Cable Tool drilling lines.

For quality wire rope for every need in the oil industry, call any leading oil field supply store or write: **Union Wire Rope, Armco Steel Corporation, 2104 Manchester Avenue, Kansas City 26, Mo.**

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FAITHFUL PERFORMANCE Independent field surveys have proven Parkersburg Chain Driven Pumping Units to be the most faithfully dependable units available. Many have been in service for over twenty years with substantially no maintenance expense — certainly a saving of time and money. Featuring quiet operation — a measure of minimum mechanical wear — the transmission incorporates high-efficiency roller chains and tapered roller bearings throughout. Multiple-strand chains with extra-heavy side plates run on flame hardened alloy sprocket teeth in a bath of light oil. Starting torque and frictional losses are minimized even in the coldest weather. The rigid, but light-weight, all-welded steel housing has a cover that is removable by loosening two bolts. Easy access, easy adjustment, and easy field replacement of any part, all make maintenance expense a minimum.

Ask your Parkersburg man for your copy of the Field Survey Report booklet.

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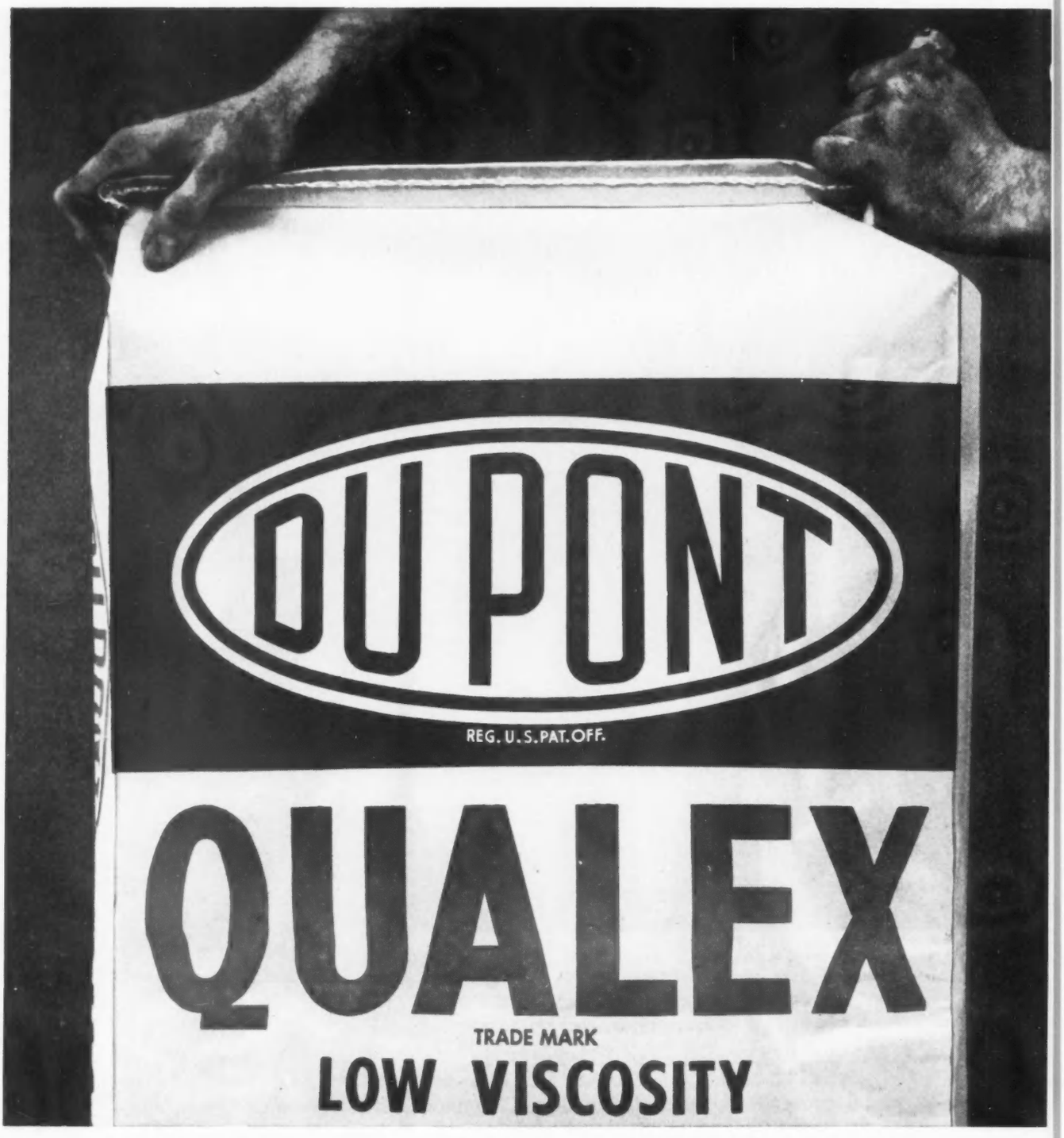
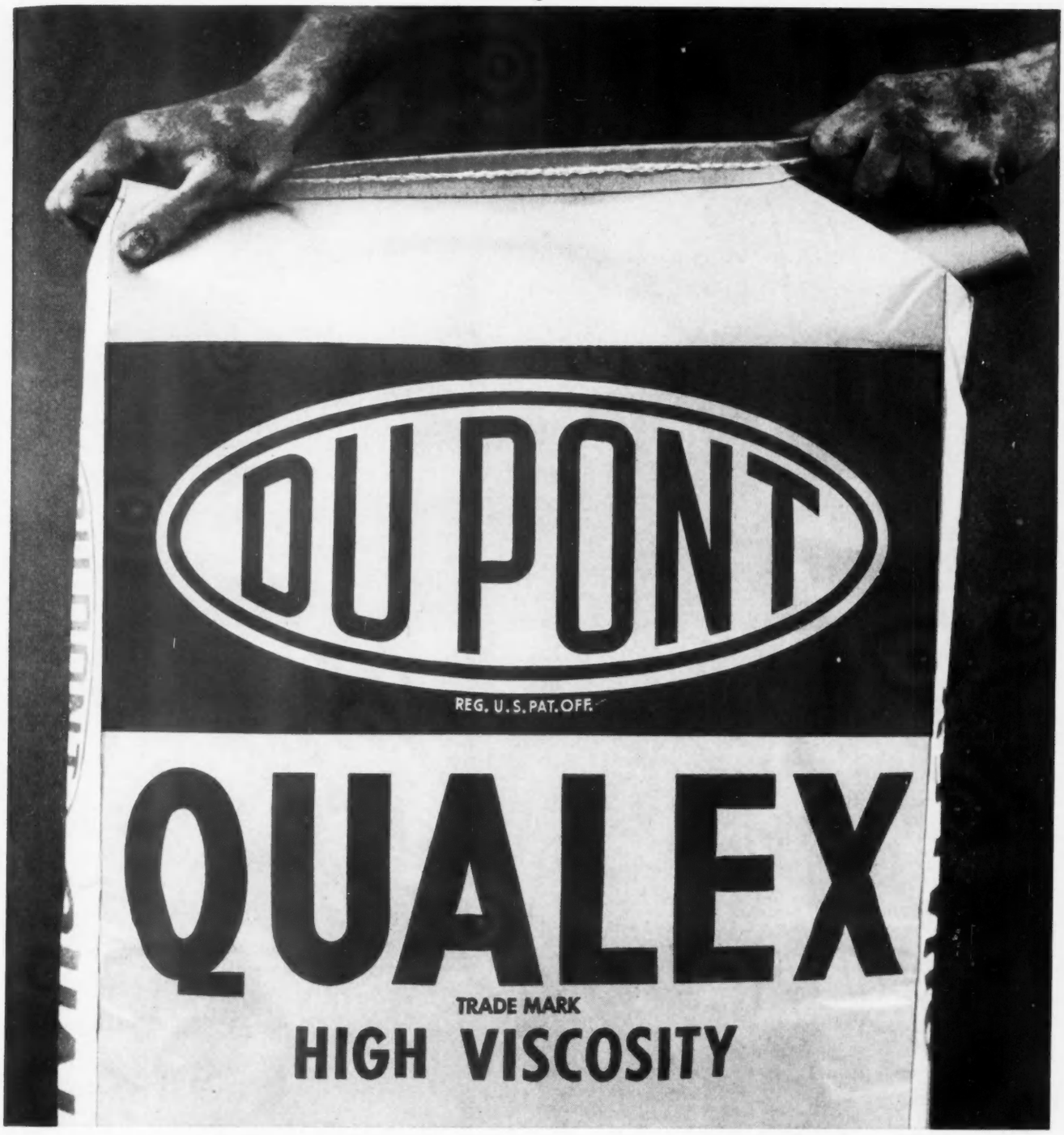


Best way to open a discussion of mud in Louisiana. When your mud has high solids, as in Gulf Coast drilling, you want to prevent fluid loss without adding viscosity. That's when DuPont Low Viscosity Qualex® enters the picture. It is specially manufactured 99.5% pure CMC that doesn't build mud viscosity. You eliminate the necessity of watering back or adding expensive thinners.

Try "Qualex" this week. All major mud companies now handle Du Pont "Qualex" and "DM" grades of sodium carboxymethylcellulose. "DM" is



Best way to rip into the high cost of mud in West Texas. Wherever low solids muds are used, as in West Texas and the Rockies, engineers are using DuPont High Viscosity Qualex® 99.5% pure CMC. Because of its extra thickening power, High Viscosity "Qualex" is more economical than competitive products in controlling viscosity at desired fluid loss levels. **DU PONT "QUALEX"**

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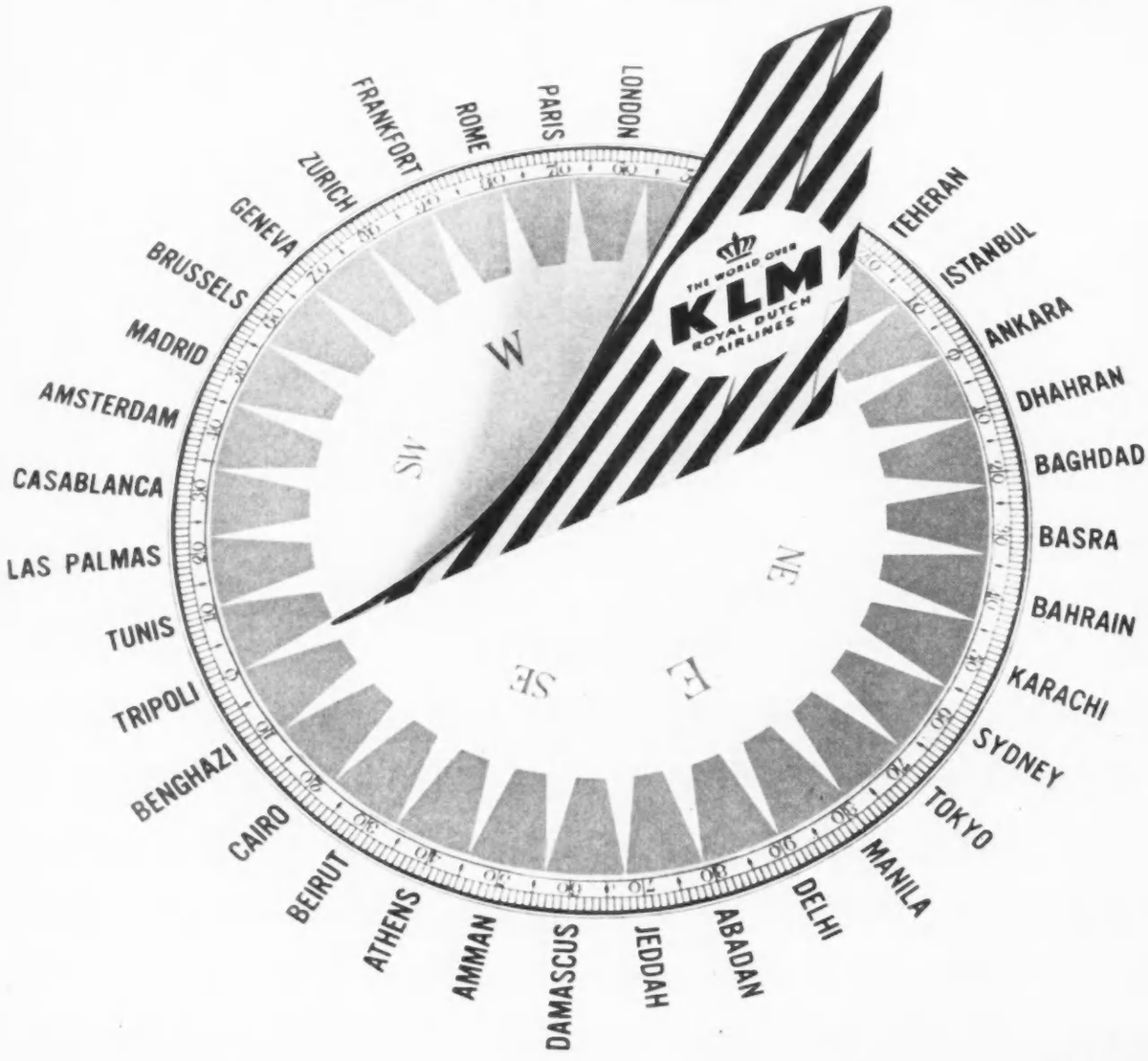

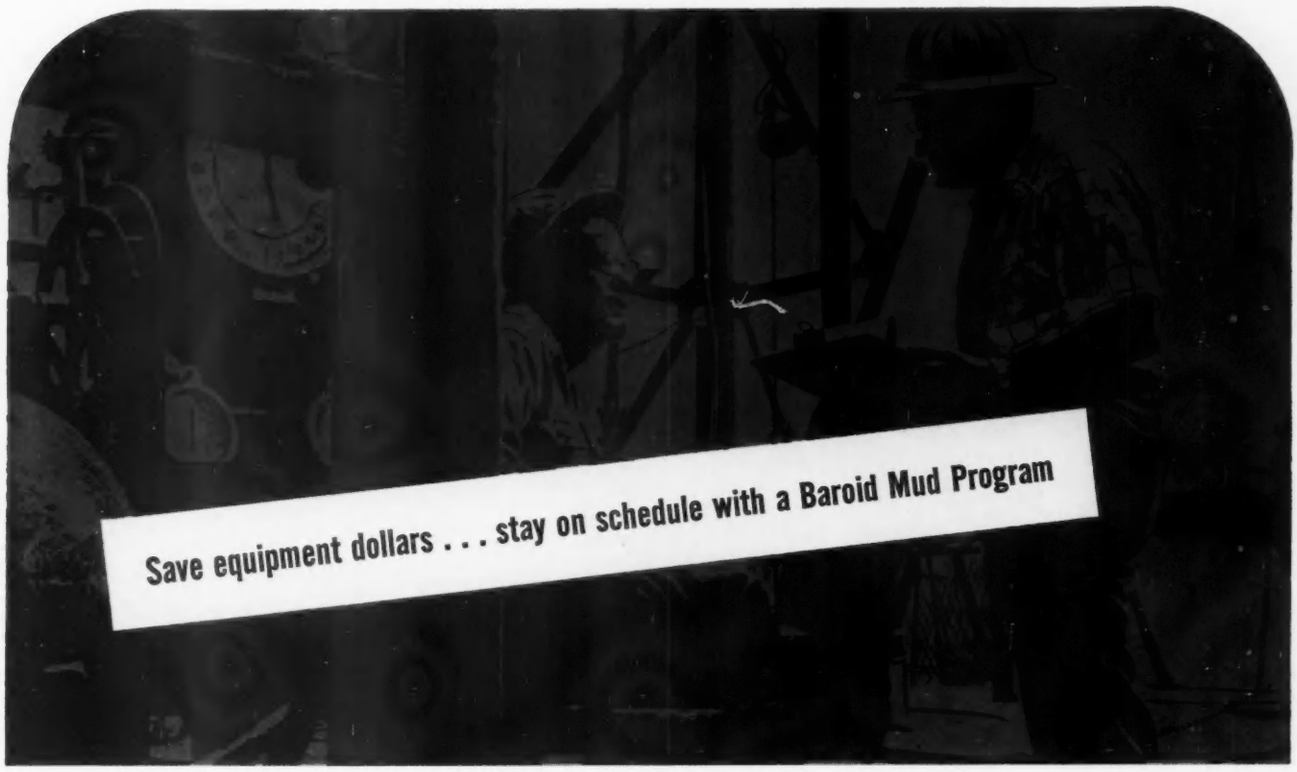

Baroid Field Report: Cass County, Texas

X-COR* solves drill pipe corrosion problem

Baroid's new film-forming corrosion inhibitor X-COR was proved again by successfully controlling drill-stem corrosion caused by hydrogen sulfide gas from the Smackover Lime formation in Cass County, Texas.

The Smackover Lime is an oil productive zone, but its corrosive sulfides severely attack drill pipe. In Cass County, pilot tests warned when the Smackover Lime formation was being entered at 11,000 feet. A slug treatment of only 2 lb/bbl X-COR was added through the pump suction and drilling proceeded to total depth of 11,200'. The flow properties of the drilling fluid remained unchanged, and the drill pipe came out of the hole free from attack by corrosion.

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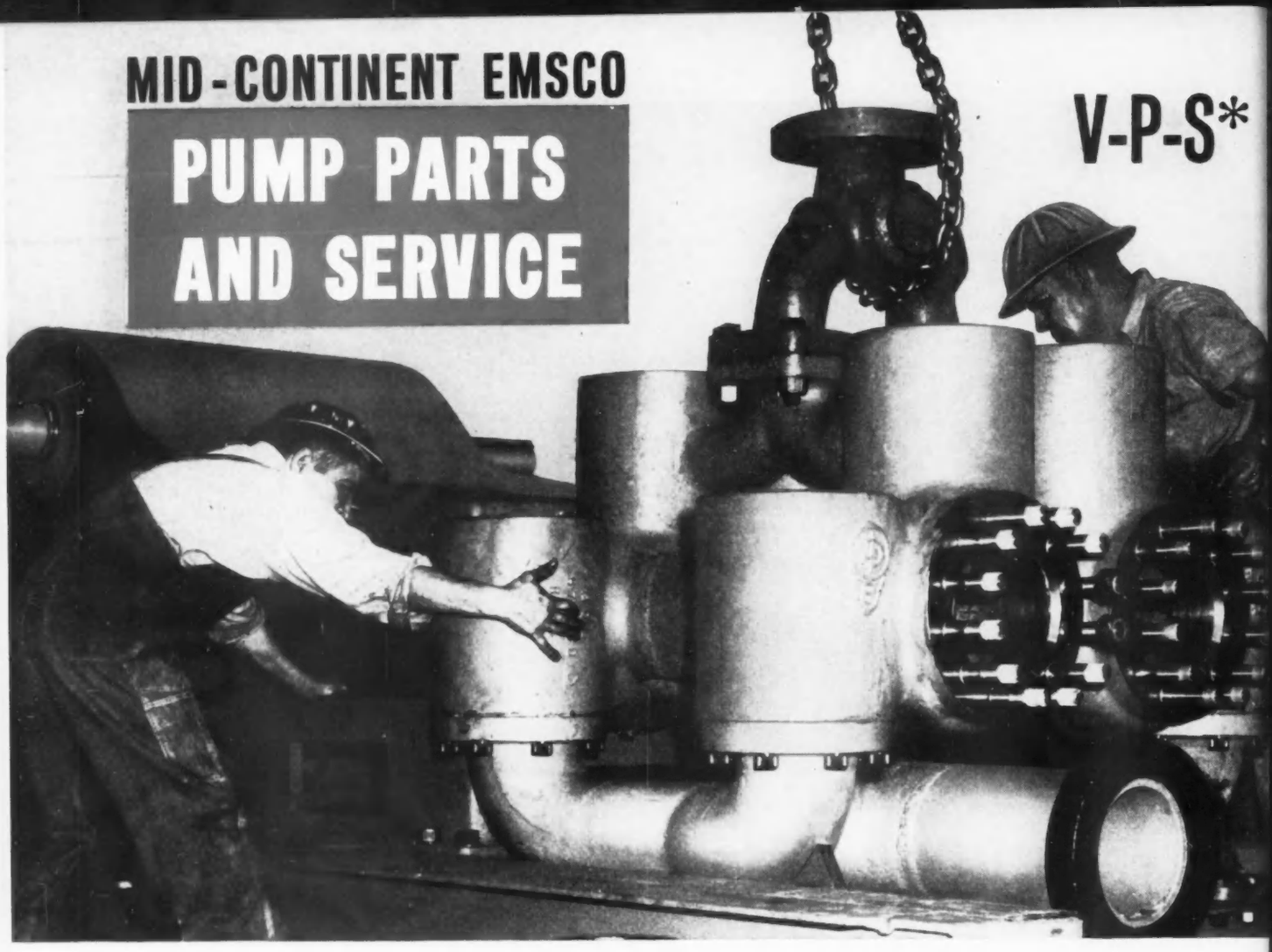

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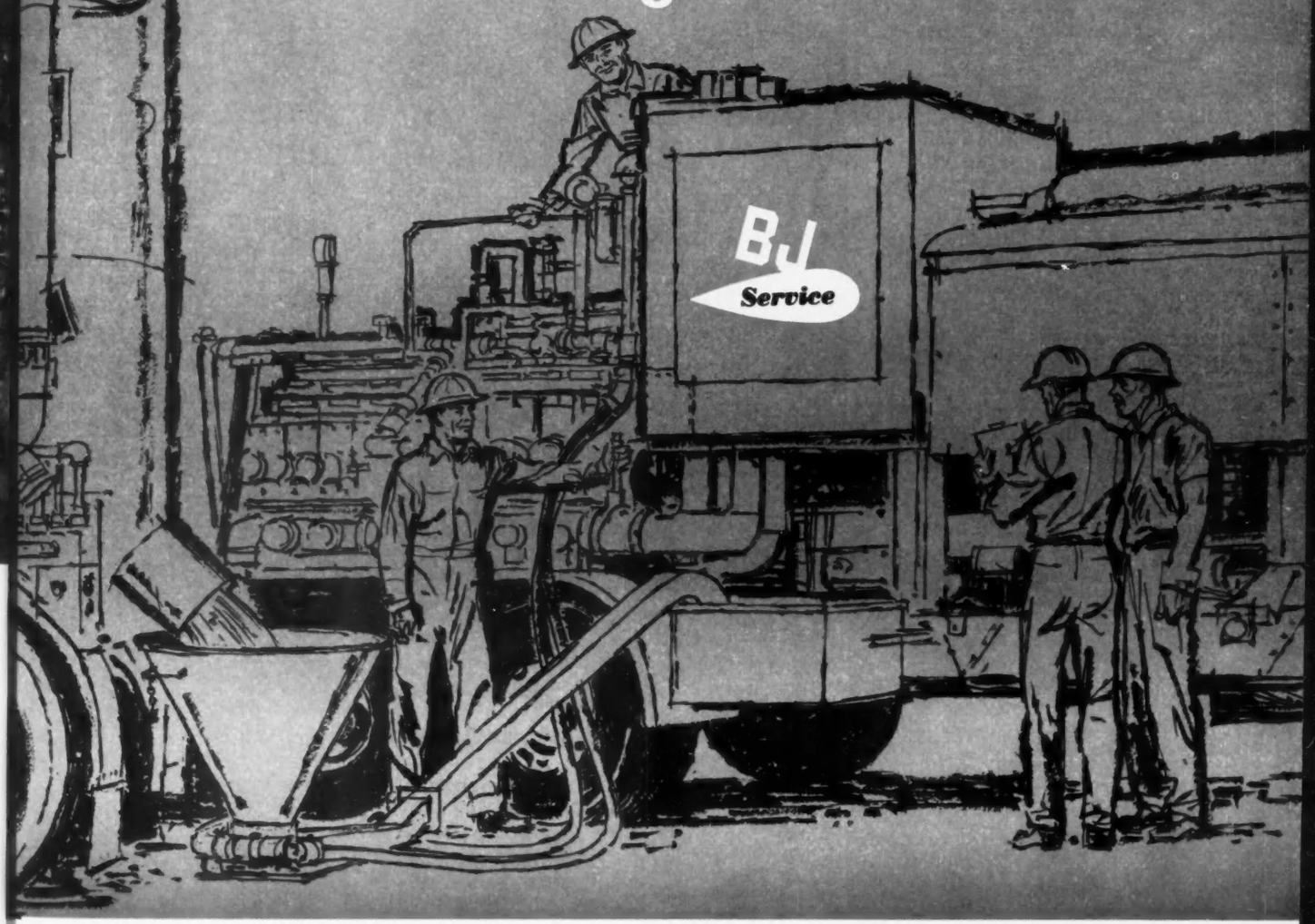
HYS-400

...the lightest, most economical cement slurry in the oil field!



Save money on your large-volume cement jobs with HYS-400—especially designed for deep wells or those with high bottom-hole temperatures. Despite its extreme economy, this high-yield slurry has outstanding over-all properties. Density rating is only 10.8 lbs./gal. (80.6 lbs./cu. ft.), making it especially valuable in cementing through zones of possible lost circulation. Fluid loss is very low—only one-fourth that of neat cement. HYS-400 has exceptional permanency, with good bond and high corrosion resistance. High resistance to mud contamination after drill-out, too. Permeability is low . . . strength in one day is good . . . thickening time meets API standards for Class E cements. You'll be money ahead by cementing your intermediate and long casing strings with HYS-400—available *only* from BJ Service.

For complete details, call your local BJ Service field station today.

Model 114-T Cementing Unit

A high-pressure cementing and pumping unit, the 114-T is designed and built by BJ Service to perform any cementing operation—no matter what the depth, pressure or complexity. It is equipped with two triplex pumps powered by two 335-HP diesel engines—can handle volumes to 1000 GPM . . . pressures to 15,000 psi.

BJ SERVICE, INC.

A BORG-WARNER SUBSIDIARY

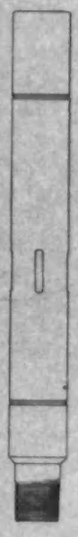
Long Beach, California • Arlington, Texas • Stations in all major oil fields

BJ B-W SERVICE

THE NEWS IS TUBINGLESS COMPLETIONS AND .

The success of these money-saving completions depends on the efficiency of the tools you use. Make the most of your operation from completion to depletion with reliable Brown equipment for: Primary cementing, Squeeze cementing, Flowing production, Artificial lift, For running multiple tubing strings simultaneously.

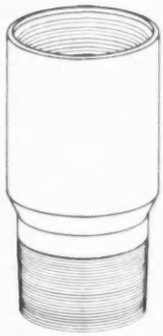
ALUMINUM SWAB WITH SHEAR PIN SAFETY JOINT
A safe tool for swabbing operations. Safety Joint assures releasing from stuck swab and remainder of tool left in hole can be disposed of by acid.



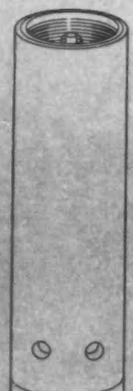
HOLLOW SUCKER ROD DRAIN TOOL
This is the tool to eliminate pulling wet tubing strings; also, a built-in jar unseats a stuck pump.

CAM-LOK TUBING ANCHOR
This versatile tool can be run either as a tension-set or as a weight-set Tubing Anchor in pumping wells.

PUMP DOWN PLUG
To insure an uncontaminated primary cement job and eliminate the guesswork involved in displacement methods, this Pump Down Plug is the answer.



LANDING COLLAR
Serves as the receptacle to stop and lock the Pump Down Plug in place and then functions as a float collar to prevent back-flow of cement.

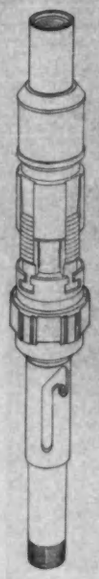


CEMENTING FLOAT SHOE
A dependable shoe with two back pressure valves to assure a pressure tight seal necessary to obtain a satisfactory primary cement job.

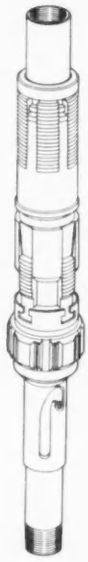
Brown tools for tubingless completions are available wherever you need them. Just call your nearest Brown representative for immediate information.

D . BROWN CAN DO THE JOB

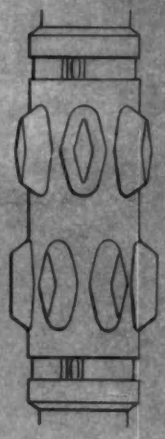
Singles or multiples—all the way



CAM-LOK PACKER
To fulfill any production packer requirement, this packer can be used as either a tension-set or weight-set production packer.

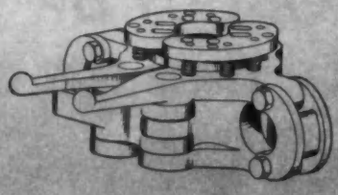


ALUMINUM CAM-LOK PACKER
For cement squeeze work, — here's the tool made of aluminum for easy removal in cases of extreme emergency.

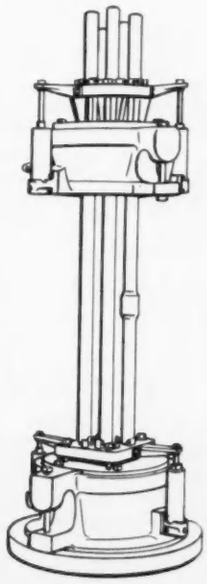


CENTRALIZER
To assure centralization of one or more production strings, these rugged centralizers do the job.

GUIDE SHOE
Manufactured from aluminum stock — simple in design and easy to handle.



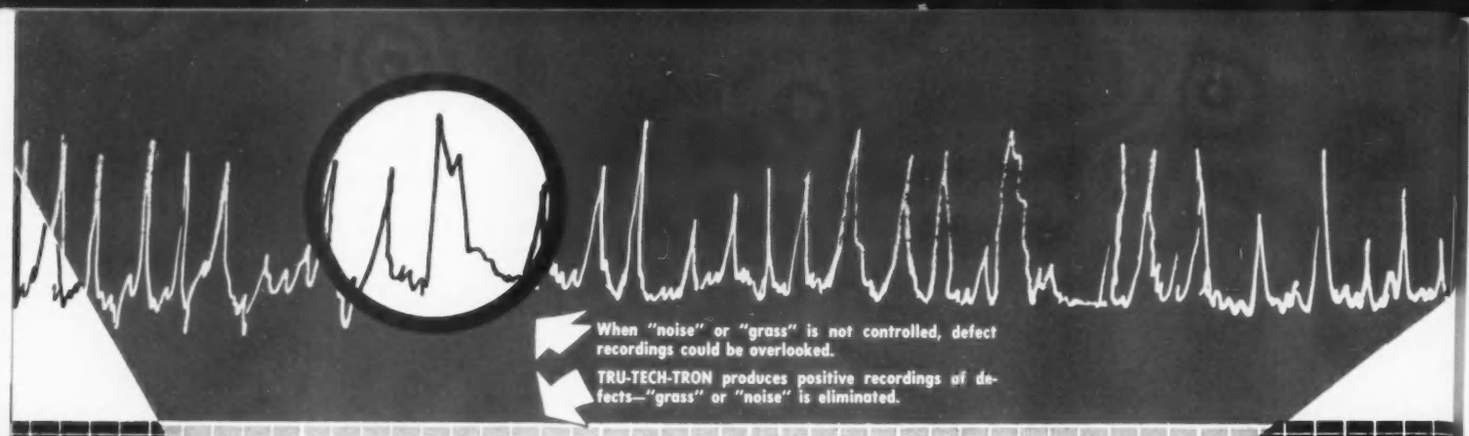
CENTER LATCH SLIP TYPE ELEVATORS
20 Ton Elevators reduced to weigh 25 pounds — extremely easy to handle and operate — for use in concentric workovers for 1" — 1¼" — 1½" regular and thin-wall tubing.



POWER-ACTUATED ELEVATORS AND SLIPS
Available for two, three, or more tubing strings, these Power-Actuated tools assure getting to bottom in record time, eliminate depth limitations imposed on tubing strings imposed by parasite ("piggy-back") method, and permit reciprocation during cementing operation.

BROWN
OIL TOOLS, INC.

8490 KATY ROAD, P. O. BOX 19236, HOUSTON 24, TEXAS


When "noise" or "grass" is not controlled, defect recordings could be overlooked.
TRU-TECH-TRON produces positive recordings of defects—"grass" or "noise" is eliminated.

NEW

TRU-TECH-TRON*

CUTS THE "GRASS" OUT OF USED TUBING INSPECTION

TRU-TECH-TRON charts are more accurate and easier to read—giving you better protection against tubing failure and preventing the wasting of good material.

Atlas Bradford Company's new TRU-TECH-TRON Used Tubing Inspection eliminates all "grass" or "noise" which might hide or obscure a defect indication. Defects show up clean and clear—there is no mistaking or misinterpreting them. If the tube is free of defects *no* indications are recorded. Signals generated by numerous unharmful defects *cannot* be added together to indicate a severe defect.

A continuous self-monitoring feature assures that each detector is working properly at all times. You learn the true condition of *every* length. TRU-TECH-TRON eliminates the hazards of overlooked defects and misinterpreted recordings—assuring better protection against costly tubing failures. Call an Atlas Bradford engineer today.

For efficiency and economy on equipment, supplies and services for the petroleum industry . . . look to Atlas Bradford Company . . . organized from Atlas Pipe, Bradford Supply, Hardy-Griffin Engineering and Universal Inspection Company . . . to better serve the petroleum industry.

ATLAS BRADFORD COMPANY

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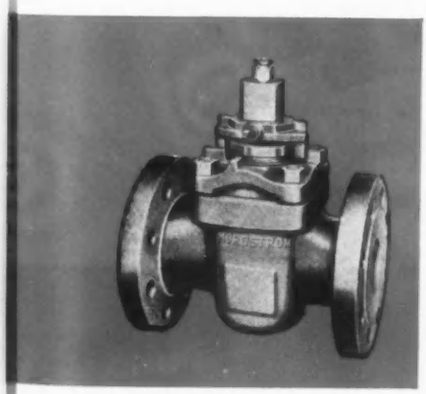
Export Office: P. O. Box 66669 • Cable: APINC—Houston

Formerly: Atlas Pipe Inc. / Bradford Supply Company / Hardy-Griffin Engineering Corp. / Universal Inspection & Service Co.

*TRU-TECH-TRON is a service mark of Atlas Bradford Company



seals tight: Let's get basic: The prime function of a valve is to shut off a line. And Rockwell-Nordstrom valves do this job better than any other valve on the market. They live longer, too, saving you money every year in valve replacement. The cost? No more than ordinary valves. Write for complete information.

ROCKWELL-Nordstrom VALVES
another fine product by
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Ours is a Republic, not a Democracy
LET'S KEEP IT THAT WAY!

Rotary Oil Tool Company

"LOCKOMATIC" Expanding Casing Section Mills...

One of the three Rotary "Lockomatic" Expanding Casing Section Mills will meet your requirements . . .

The MJC (Milling—Jet Washing—Cementing) Tool—Mill the Casing Section, Jet Wash the Hole and Jet in the Cement Plug—all in one round trip. Doing the job in one round trip saves rig time. Jet washing removes the loose or soft formations, fractured cement and the mud ring. Immediately jetting in the cement plug eliminates the re-build up of the mud ring —thus a perfect plug job is assured.

The MT (Milling) Tool—For milling Casing Sections, when centralizers will be encountered, bad casing or other extreme conditions will have to be contended with.

The Regular Tool—For all regular Casing Section Milling and opening the hole after milling the section.

Rotary "Lockomatic" Expanding Casing Section Mills will mill all sizes, weights and grades of casing.

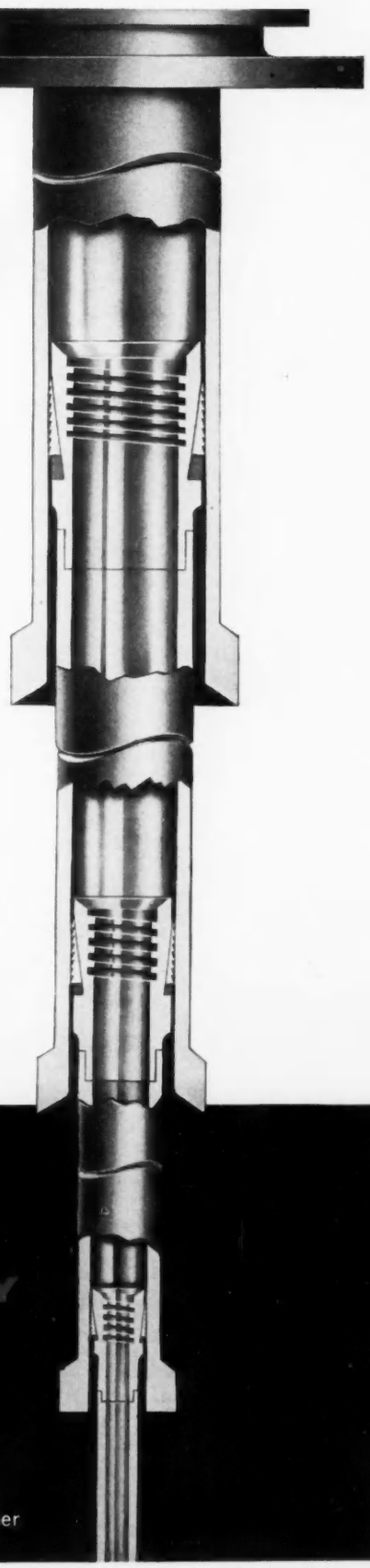
The ROTARY OIL TOOL COMPANY "Lockomatic" Expanding Tools have never been stuck in a hole, due to cuttings fouling the mechanism or failure to unlock. Rotary's "Lockomatic" Casing Section Mill will NOT hen-skin casing in high angle holes.

Rotary Oil Tool Company

Serving the industry over 20 years

8655 Whitaker Ave., Buena Park, Calif. • LAmbert 6-4621 • Cable ROTOILTOOL

Standardize on Burns Casing Hangers and SAVE Completion Costs!



Today's allowables make it imperative to reduce the cost of oil well completions. Keep up your present drilling commitments with less investment per well.
Use a Burns Casing Hanger!

The displacement of the slip is arranged to distribute the load uniformly around the water string, giving the water string maximum protection. Suspend on bottom, overlap 100 feet in the protective string and cement the overlap.

ELIMINATE THE HAZARD OF CASING CONTACTING THE WALL OF THE HOLE

Get a uniform annular space around the casing shoe for cementing in high angle holes by suspending with a double Slip Burns Casing Hanger. Suspended casing centralizes itself and is perfectly aligned with the axis of the hole, in tension, free of bends, assuring a good cement job.
Each slip carries its own load, independently distributing the load equally over the entire slip area.
Circulation grooves milled in the body reduce the velocity around the hanger, assuring a better cement job.
Cementing the well can be done either before or after the hanger is released.
SAFETY: The double-slip Burns Casing Hanger can be set with the proper stretch on the casing, even though the pipe is frozen, by rotating the running-in string six turns to the right. This allows the slips to raise against the protective string and suspend the frozen casing properly.

Write today for complete product catalog

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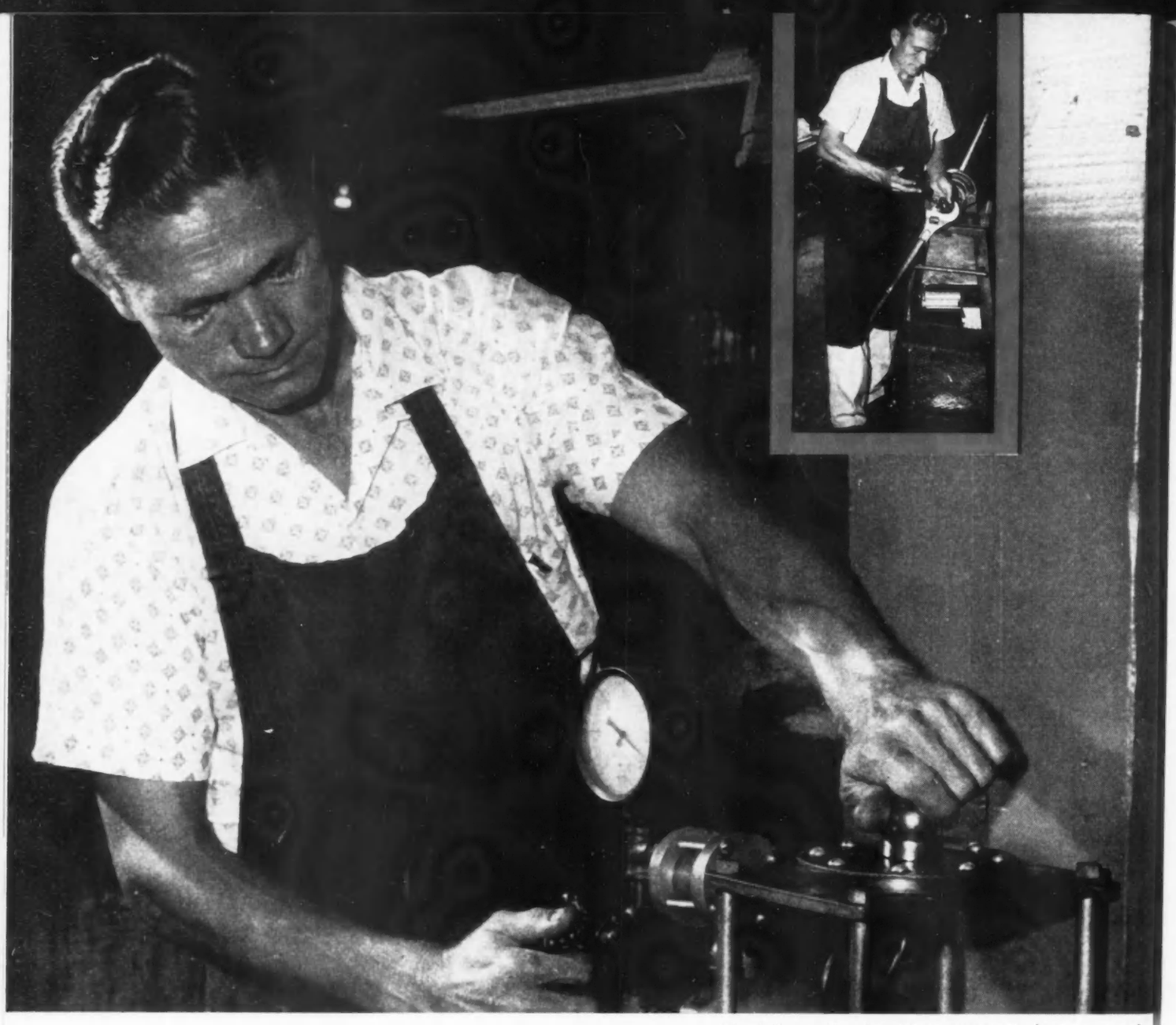

Lloyd Curry, Houston store pump repair man, running vacuum machine leak test on ball and seat

You can't see the biggest item that goes into a pump repaired at Wilson Supply . . . It's SERVICE!

The biggest single item that goes into a pump repaired at your Wilson store is *service*. As you would expect, the pump repair men at Wilson Supply have the proper testing equipment, complete spare parts inventories and know-how to repair your sub-surface pumps *properly* and *promptly*.

But when it comes to service, you can see a difference! Your Wilson pump man knows how important it is to get your pumping well back on production. He will work round-the-clock, weekends and holidays — if that is what it takes.

For fast field pump repair service, call your Wilson Supply man. You will receive the kind of service that saves you production dollars.

WILSON SUPPLY CO
HOUSTON, TEXAS

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1 LEAK-PROOF CONNECTIONS

2 POSITIVE SEATING

3 CLEAN/OVER-ALL PROTECTION

4 EASY WRENCHING FAST MAKE-UP

1,000,000 × 4

More than one million Capitol forged steel unions are now in service . . . and not a single failure! Capitol has 4-way built-in insurance to give trouble-free service. Each one of the million has this exclusive combination of 4 engineering features:

(1) *Leak-proof connections* assured because Capitol unions have *more* threads, accurately cut and double-checked according to Army-Navy gauging practice. Both hand-tight and pressure-tight threads are checked, two operations instead of the one required for American Standard gauging. The extra threads mean on-the-job assurance of tight installations. (2) *Positive seating* because each union is individually pressure-tested. (3) *Clean/over-all protection*, each male and female part completely phosphate coated; each nut electro-zinc plated. (4) *Easy wrenching/faster make-up* because all three parts have a definite octagon shape.

You get all 4 important advantages at no extra cost when you specify CAPITOL forged steel unions . . . one of the full-line of Army-Navy gauged forged steel fittings. Now more than one million in service . . . and not a single failure.

CAPITOL MANUFACTURING CO.,

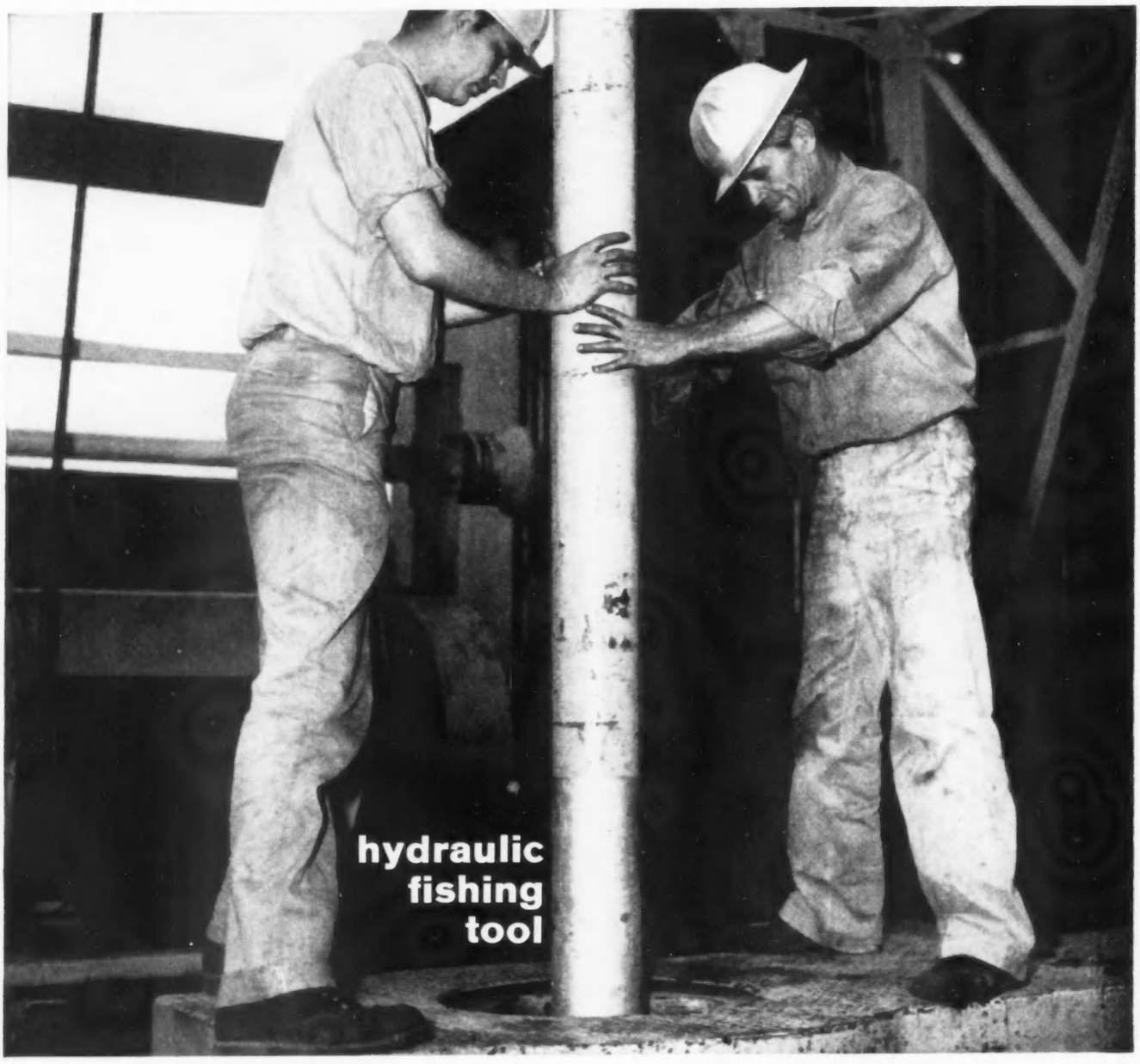
Division of Harsco Corporation, Columbus, Ohio.

CAPITOL

SPECIFY CAP FOR ALL FITTINGS

SOLD ONLY THROUGH RECOGNIZED DISTRIBUTORS

For more data on advertised products, use cards, last page.



Delivers a 300,000 pound "knock-out" punch; critical parts are 4340 nickel alloy steel

. . . it provides the hardness, impact resistance, and strength needed to withstand the shattering impact.

Every time this hydraulic "sledge hammer" is run down a well to free stuck pipe, 4340 nickel alloy steel is put through one of the severest tests of a metal's strength and impact properties.

Blows of over 300,000 pounds are delivered by this Bowen Hydraulic Rotary Jar when "fish" are stuck tightly. But time and time again, this through-hardening nickel alloy steel proves it has the high mechanical properties to withstand the crippling impact.

THE TOUGH JOBS GO TO NICKEL ALLOY STEELS. Because of their outstanding strength—their high fatigue and impact resistance—producers have come to depend on nickel alloy steels for long, reliable service in the most demanding applications. Rock bit cutters, for example. Hole reamers. Drill pipe. Sucker rods. Fishing taps. In these applications, nickel alloy steels prove their dependability by providing *trouble-free* performance.

WHAT ABOUT YOUR EQUIPMENT? Do you need materials with greater strength and toughness, with greater impact resistance? Do you need materials that respond readily to heat treatment? Nickel alloy steels may prove to be your answer. For complete data, send for your copy of "The Properties of Heat Treated Wrought Nickel Alloy Steels." A postcard will do it.

TYPICAL MECHANICAL PROPERTIES
4340 nickel-chrome-moly steel

Tensile Str. 1000 psi		Yield Str. 1000 psi	
As Rolled	192	As Rolled	147
Annealed	119	Annealed	99
Hard. & Temp.[a]	150[c], 220[d]	Hard. & Temp.[a]	130[c], 200[d]
Hardness (Brinell)		**Impact Str. ft.-lb.**	
As Rolled	380	Izod. Hard.	
Annealed	240	& Temp.	73[c], 16[d]
Hard. & Temp.[a]	310[c], 445[d]		

[a] Properties after heat treatment are based upon oil quench and 1-in. round bars.
[c] Tempered at 1200° F [d] Tempered at 800° F

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street INCO New York 5, N. Y.

INCO NICKEL

NICKEL MAKES STEEL PERFORM BETTER LONGER

Oilfield Pipes

are inseparably connected with the development of the petroleum industry. For decades, PHOENIX-RHEINROHR has essentially contributed to the achievements made in the drilling technique by furnishing standardised API steels and special steels as well as high-strength joints. Our

Drill Pipe
Casings
Tubing and
Line Pipe

afford maximum operating safety.

We are privileged to use the API monogram.

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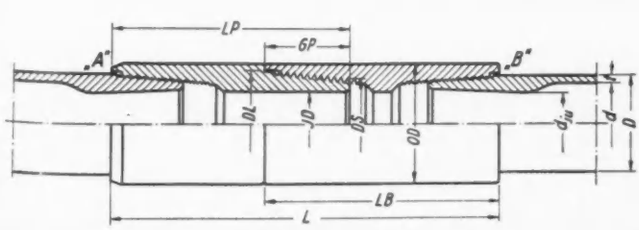

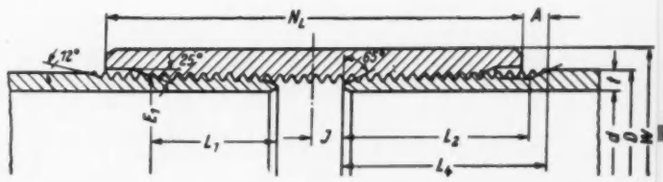

OLD HAND AT TUBINGLESS COMPLETIONS

First to recognize the economic importance of "tubingless" completion techniques, Texas Iron Works pioneered the design and development of small diameter tools to provide maximum efficiency at minimum cost.

In design, in materials and in precision manufacture, T-I-W Tubingless Completion Tools represent the finest that modern science has developed . . . the result of more than 40 years of continuous experience in providing quality production equipment.

T-I-W Tubingless Completion Tools have been thoroughly and satisfactorily field tested in numerous West Texas, South Texas and Gulf Coast area wells . . . providing an outstanding record in economical completion.

Field-trained T-I-W service engineers can provide case history details to assist you in your Tubingless Completion program.

Call, write or wire for complete details on the T-I-W line of Tubingless Completion tools, immediately available anytime . . . anywhere.

1—T-I-W Type AH Packer, with Hold-Down Slips
2—T-I-W Type AH Packer, less Hold-Down Slips
3—T-I-W Type RLO Tubing Safety Joint
4—T-I-W Tubing Centralizer
5—T-I-W Double Box Tubing Landing Collar
6—T-I-W Male Type Drillable Tubing Guide Shoe
7—T-I-W Double Type Tubing Wiper Plug
8—T-I-W Ball Type Tubing Wiper Plug

The only wiper plugs on the market that will not rotate if it becomes necessary to drill out.

Manufacturers of: T.I.W. Portable Rigs . . . T.I.W. Safety Joints . . . T.I.W. Rotary and Casing Slips . . . T.I.W. Grief Stem Safety Valves . . . T.I.W. Packers for every purpose . . . T.I.W. Pump Chambers . . . T.I.W. Mudmixers . . . and many other oil field tools.

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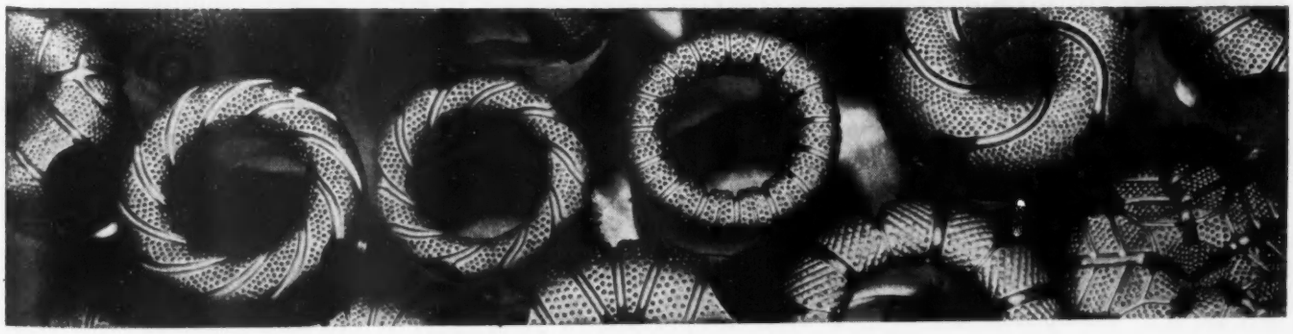
SERVICE FROM WORLD-WIDE SALES OFFICES AND MANUFACTURING PLANTS



Dependable 'til the cows come home and then some!

. . . and economical, too! . . . that's the record of fields electrified with Utility Electric Power! Every year more and more operators are turning to the one economical form of power they can depend on year after year with constant efficiency and low cost operation. It makes sense that in your operation . . . whether ordinary production, waterflood, gathering . . . that you depend on the economies of purchased electric power through your nearest utility company.

Petroleum Electric Power Association

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NEW FROM CAMCO...

the Industry's most complete line of

Pilot-Operated Valves

Conventional and Retrievable . . .
Large-ported for deep intermittent lifting

Camco now introduces the most complete selection of pilot-operated gas lift valves available to the industry. Both conventional and retrievable types are manufactured, for installation in **standard Camco Mandrels:** The **CP-1** and **BP-1** valves for Camco C and B Conventional Mandrels respectively, the **RP-1** and **PK-1** for Camco MM and K Sidepocket Mandrels respectively, and the **RPB** retrievable pilot-operated bleed valve for chamber installations.

These large-ported valves are ideal for dual gas lift and for deep intermittent lift where injection gas pressure is low relative to depth.

Control of spread—Valve spread can be changed by varying port size in pilot section.

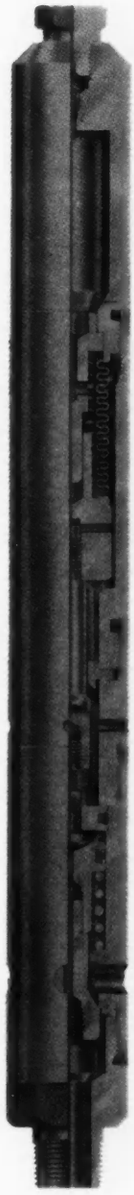
Large gas passage—Main inlet valve is large-ported regardless of pilot valve spread, allowing maximum injection gas to enter tubing.

Snap-acting main inlet valve opens and closes without throttling.

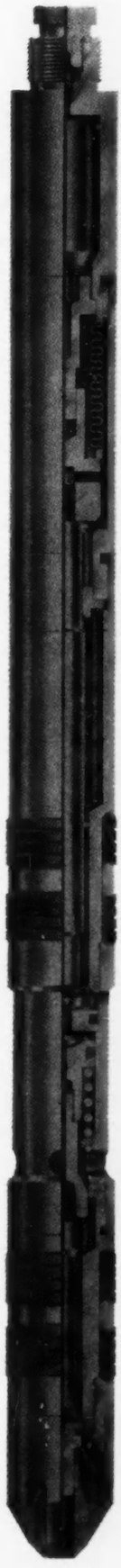
Simplicity—Main valve is a simple, sturdy spool valve.

Proven design—Pilot sections have design and construction features of Camco gas lift valves proven by many years of field use.

New Camco Pilot-Operated Valves are backed by the industry's greatest experience in designing and building gas lift valves. For more information, call your Camco representative or write



CP-1 VALVE



RP-1 VALVE

CAMCO

"PRODUCING PETROLEUM PROGRESS"

CAMCO, INCORPORATED

Box 14484, Houston 21, Texas

CAMCO, LIMITED, Belfast, U.K. - CAMCO DE MEXICO, S.A., Mexico, D.F

We put a lot of work into it — You get a lot of work out of it

Quality inside and outside

Here are two "close-ups" of Roebling Royal Blue Wire Rope which show in part where your savings come from . . . uniformity of structure. Invisible, but equally important, is Royal Blue's *extra* high tensile strength. All the way through, Royal Blue pays off for you on every kind of wire rope job. Find out more from your wire rope distributor, or write for free booklet to Roebling's Wire Rope Division, Trenton 2, New Jersey.

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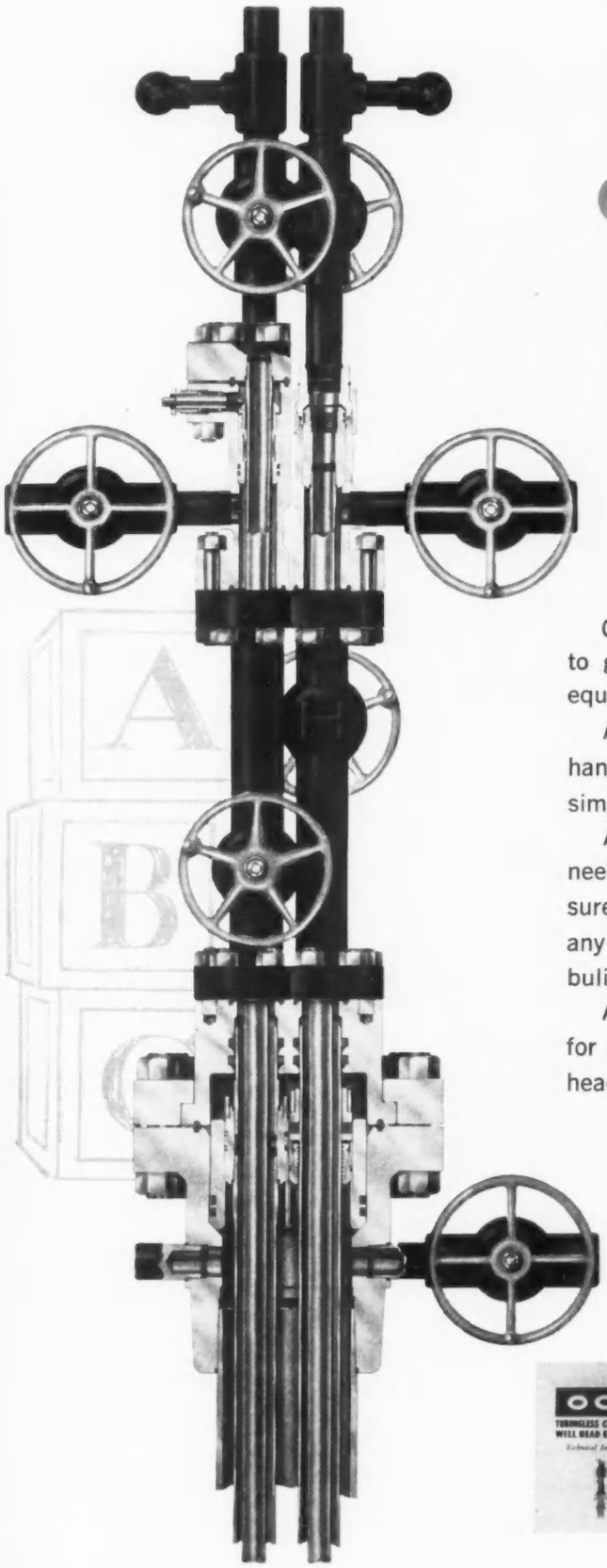

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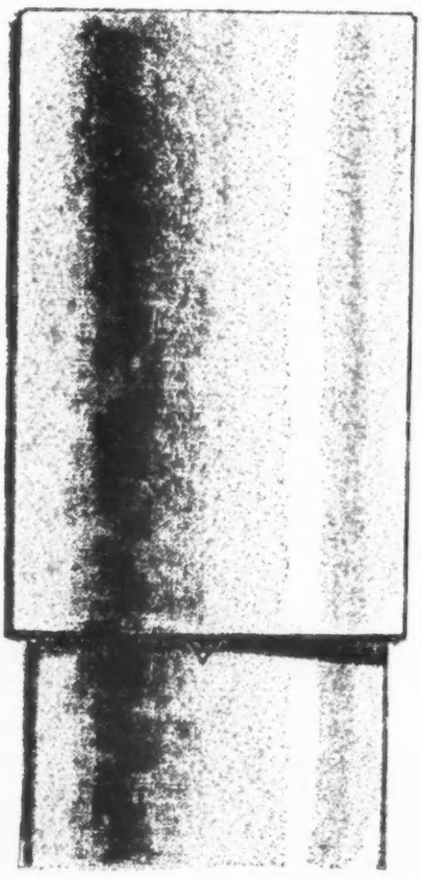

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Lucey Products Corporation
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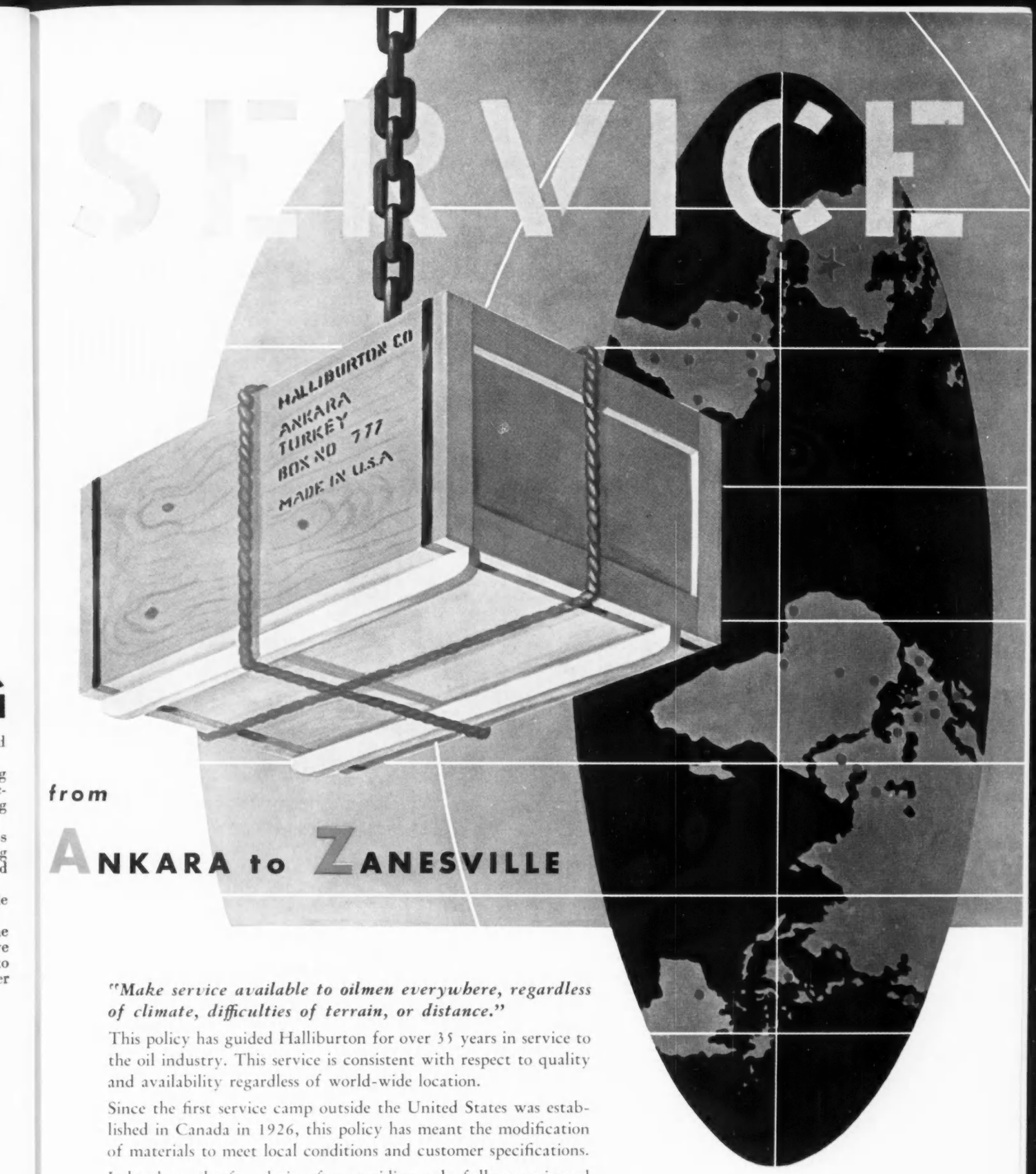

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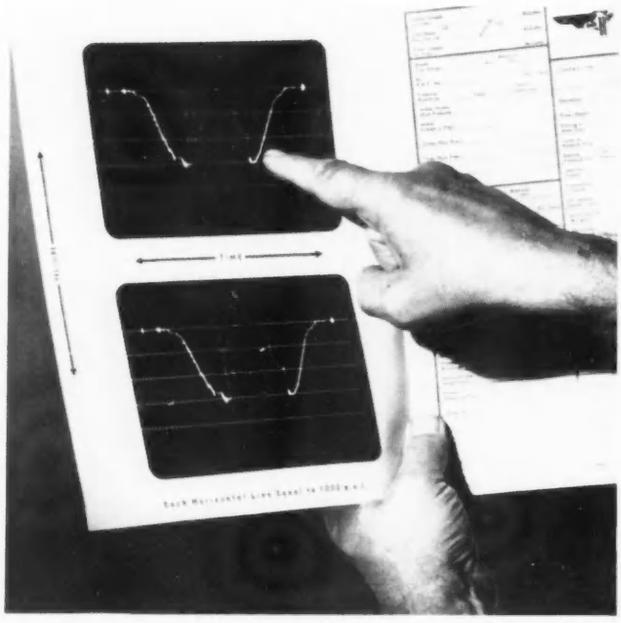

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Red oil offensive
How to check it

By Don E. Lambert
World Oil Staff

"Soviet political leaders, engineers and strategists have discovered the importance of oil as a political and trade weapon, and are now earnestly intent on using oil to the fullest in their conquest of the Free World."

These recent remarks by Illinois Senator Everett Dirksen before Congress sum up warnings economists and oil industry leaders have been issuing repeatedly for three years. Now, it appears that something will be done about it—if a means can be found to crystallize the many excellent plans for a counter-offensive that have been offered in recent months.

In evaluating the need for a counter-offensive, and decisive action to implement it World Oil has checked every available source to answer four questions:

1. How far has the Communist oil threat progressed?
2. What may be the result if Red exports continue to increase?
3. Can Russia flood the Free World with Red oil over a prolonged period?
4. What can the Free World do to dam the flow?

Here are the answers.

How far has the Communist oil threat progressed?

Three years ago, economist Eliot Janeway and others warned of Russia's plans to use Middle East and its own oil to disrupt world markets. Only in recent months has anything been done about it. And that effort, for the most part, has been devoted to determining the "extent of the problem." How much more time will be spent firming up a solution, then taking correct, decisive action, apparently only Free World leaders can tell.

Within five years, USSR crude oil and products exports have more than quadrupled, from a trickle of 21 million barrels of crude and 37 million barrels of products in 1955, to 120 million barrels of crude and 121 million barrels of products last year. Plans are to increase exports of crude and products from 241 million barrels in 1960, to 359 million barrels in 1965 and 583 million by 1970—nearly 2½ times the 1960 total.

In 1955, about 41 percent of Russia's crude and product exports went to Free World countries. Currently, the ratio is about 56 percent, and plans are to increase to 60 percent by 1965.

Russia's share of the world trade is small at present—about 4.5 percent. However, the Communist intention is to expand its share of the market in proportion to its ability to produce. The immediate aim appears to be a 14-30 percent share of the world trade, about the same percentage the Russians had from 1922 to 1940.

Indications are that Russia will try to achieve its oil export goals by sharply increasing production and by gearing more of its industrial fuel use to natural gas.

Upon his recent return from a 30-day visit to Soviet gas installations, Baxter D. Goodrich, Texas Eastern Transmission Corporation senior vice president reported Russia will more than triple its natural gas output between 1960 and 1965—from 165.2 billion cubic feet annually, to 525 billion cubic feet. Also, Russian use of natural gas, about 89 percent industrial and 11 percent private consumption in 1960, will change to 95.4 percent industrial and 5.5 percent private use by 1965.

These facts from Library of Congress, the Congressional Record and other government sources show the inroads Russian exports have made to date:

An Interpretive Look at
WHAT'S HAPPENING

► Russia now supplies all the oil used in Iceland, 95 percent of Finland's requirements, 40 percent of Norway's industrial oil needs, and 13 percent of Sweden's. It is the principal supplier of industrial oils for Denmark and supplies 24 percent of Greece's market. Also, it supplies most of the oil required by its satellite nations—East Germany, Poland, Hungary, and Czechoslovakia.

► Last December, Japan made a trade agreement with the Soviet Union. Under that pact, Japan will take 10 million barrels of oil this year and 12.5 million barrels in 1962.

► Brazil has cocoa, coffee and meats. Khrushchev has oil. Khrushchev takes Brazilian commodities and Brazil takes Soviet oil. This agreement involves $100 million. Also, because our government has been talking hard but acting little concerning Brazil's request for aid in developing its vast shale oil reserves, Brazilian technicians recently visited Moscow to discuss a deal with the Russians.

► Italy's government owned oil monopoly, ENI (headed by the controversial Enrico Mattei), is buying 30 million barrels of oil from Russia annually for four years at about half the price of Persian Gulf crude, in exchange for 240,000 tons of steel pipe, 50,000 tons of synthetic rubber and other oil pipe line equipment. Mattei, who apparently is proud of his reputation as the biggest European buyer of Russian oil for resale to Free World countries that outwardly say they are limiting Russian oil imports, is now taking a long range look at the possibility of building an Italian crude oil line that will hook up with the line Russia is building from the Baku region to East Europe satellite nations.

► In Argentina, the state oil company has been receiving drilling equipment from the Soviets under a $100 million credit agreement signed in 1958. Other Latin American countries have also been informed, through diplomatic channels, that Moscow can do as much for them. Currently, Bolivia, British Guiana and Brazil are major targets.

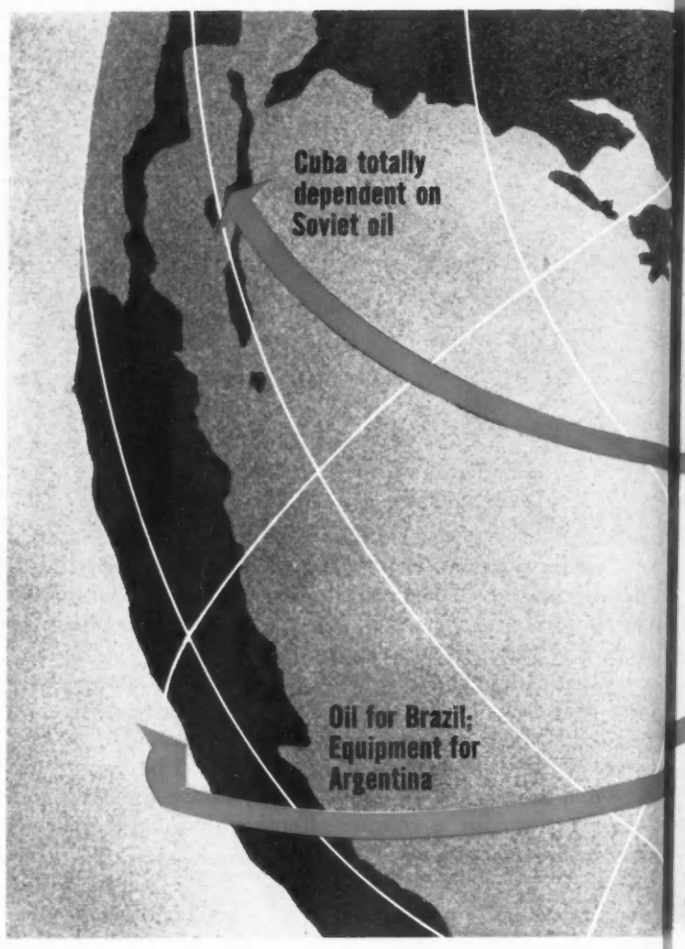
► As announced last February, the Soviet Union will provide our staunch ally Pakistan with $30 million plus exploration crews, drilling and other equipment to aid the country in its effort to prove up its own oil and gas reserves.

► Soviet exploration crews are searching for oil and gas in Syria, Iraq, Afghanistan, Ethiopia, Ghana, and possibly other areas. The Soviet oil industry has been sending drilling and refinery equipment to India, Ethiopia, Iraq, Argentina, and elsewhere.

► All of Cuba's oil needs now are being supplied by Russia—about 70,000 barrels daily. Although the Communists are short on tankers, Free World firms appear more than willing to pick up the extra revenue. In return for a five-year supply of Russian oil, cash and commodities, Cuba will barter away about 1 million tons of sugar.

This general review of the current status of Russia's oil offensive brings up the next major question.

Russia's oil tentacles



What may be the resu

A political stranglehold on every free, but oil-deficient nation that becomes entangled in the insidious Communist economic trap.

An increasing loss of oil markets for Free World firms already burdened with far more oil than they can sell, with resulting downward pressures on prices.

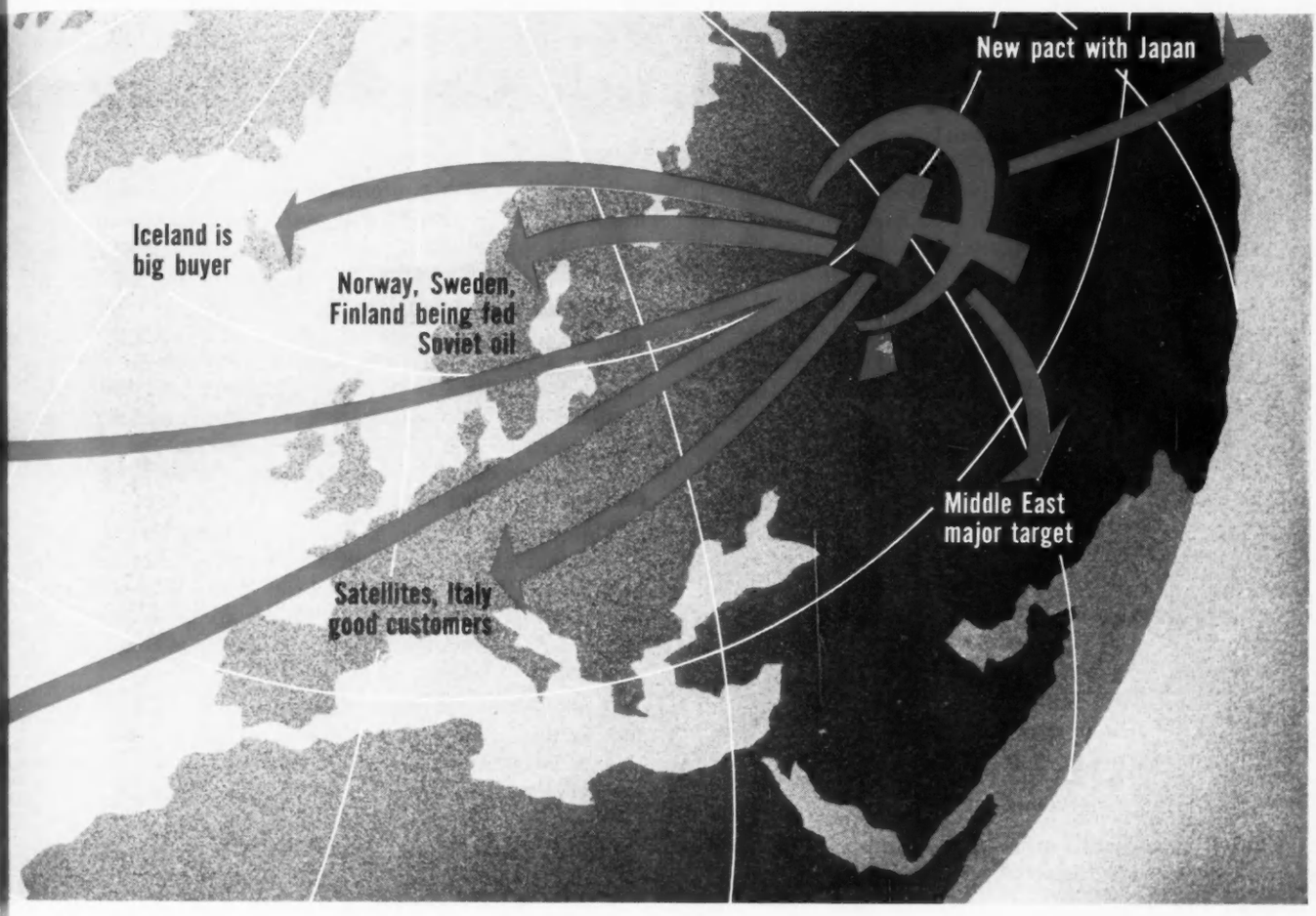
In turn, lower prices may force Middle East and other major oil exporting nations to demand higher royalties to offset loss of income resulting from the downward price trend. To maintain their economic position, U.S. oil companies with heavy overseas investments may be forced to press harder to increase U.S. imports, thus putting a further damper on an already depressed domestic oil industry.

A growing trend on the part of some Free World countries to jeopardize their religious, political and economic independence for cheap oil.

Because the consumption rate has not progressed according to plan, Russia has an increasing oil surplus. However, industrial and private needs for other commodities are growing faster than Russia can produce them.

Result: Russia is getting rid of its excess oil, obtain-

reading throughout the Free World


New pact with Japan
Iceland is big buyer
Norway, Sweden, Finland being fed Soviet oil
Middle East major target
Satellites, Italy good customers

Red oil exports continue to increase

ing the commodities it needs and strengthening its economic position through barter and back door deals with Free World nations that are willing to put their independence on the line for cheap oil tainted with human suppression and atheism.

Political overtones are ominous. In all the countries where Soviet strategists and technicians have gained a foothold, however precarious, they are using their presence to arouse the political consciousness of the local leadership.

This economic operation serves as the platform from which to bring "political knowledge" to the former colonial countries, to "help" them in the direction of adopting the totalitarian scheme of economic development, including the grisly elements of permanent dictatorship, purge and terror.

The Communists will continue to use the demonstration effect of their economic aid to help place into circulation two "lies" which they expect to utilize as powerful forces in the contest for influence among the underdeveloped nations. They are:

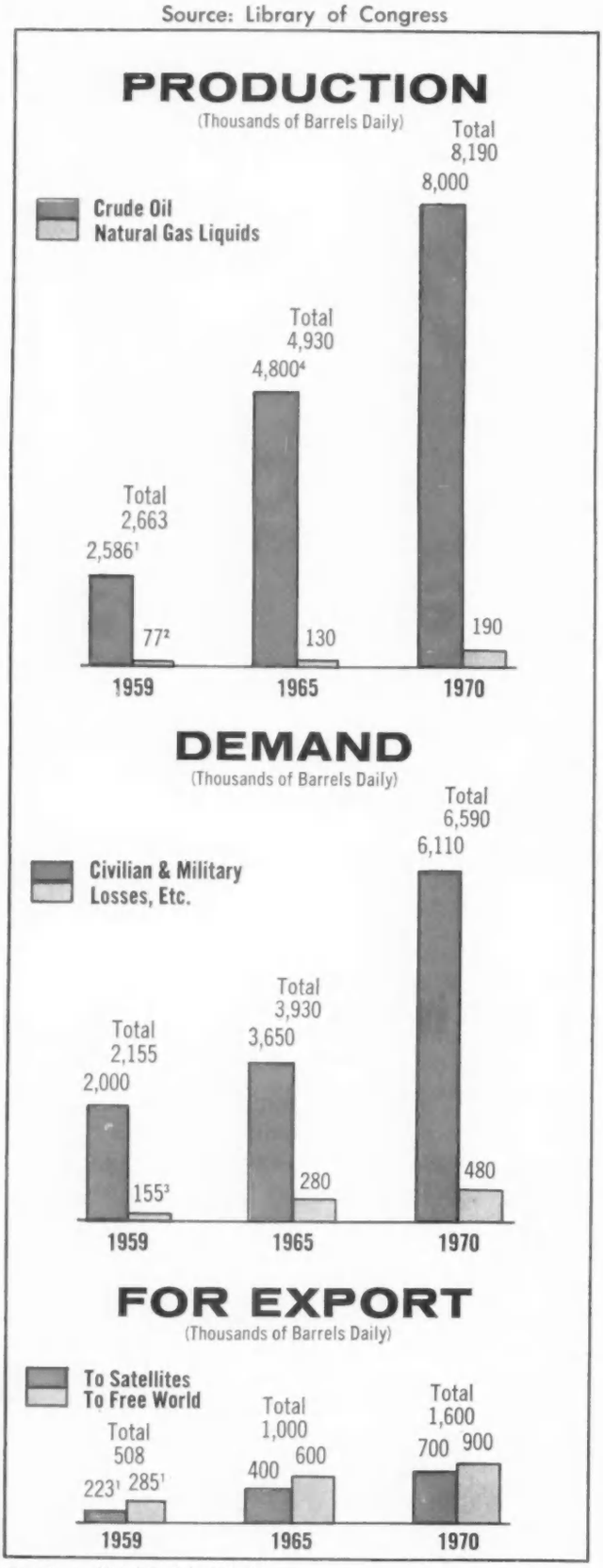
Lie No. 1. The Communist economic method is the only sure-fire method to convert a former backward country into an advanced, capital-exporting industrial nation.

Lie No. 2. The Western oil companies and the nations they represent are self-seeking, profit-hungry, rapacious monopolies bent on perpetuating the economic backwardness of the less developed oil-rich countries.

Should Russia achieve its economic and political aims using such lies, one of the strangest paradoxes of all time will emerge. Oil, a major contributor to the rapid uplifting of civilization the past 100 years, will become a key factor in some nations falling prey to an ideology that will set them back far more than 100 years, to the times when Communism first was tried—and failed miserably. The Pilgrims tried a form of it in the 1600s shortly after they came to America and tossed it aside when they discovered they were losing what they came here for—individual freedom.

Soviet Oil Exports Expected to Triple in 10 Years

Source: Library of Congress



¹Based on official Soviet statistics.

²Residual figure to balance; appears reasonable in light of other published estimates.

³Estimated at 6 percent of crude production.

⁴Based on Soviet plan.

Can Russia increas

From all available information, yes—both from a political and an industry standpoint.

The political atmosphere is important in evaluating Russia's ability to maintain a prolonged oil offensive. In the Soviet Union, oil is a government-owned industry. There is no Congress or Legislature to harass it; there are no investigations except those the Red leaders wish to impose; and there is no limit whatsoever on the trade methods it might employ to open foreign markets for Communist oil; no need to make a profit if the political results are acceptable; no accounting to be made to stockholders; no strikes by labor.

Thus, Russia can set a double standard for its crude oil prices. Data recently published by the Soviet Ministry of Foreign Trade blatantly shows that average prices for crude oil going to Free World nations is $1.89 per barrel, while the price to satellite nations averages $3.02 per barrel.

It is one complete, uninhibited operation, designed for specific results and directed by iron hands. Given such powers over an industry whose product is indispensable to every country on earth, it becomes immediately apparent what a threat this can be to the Free World.

One of the greatest threats from Soviet oil lies in the bilateral trade practices, wherein a country such as Italy imports Russian crude to help supply the state-owned marketing outlets in other European countries and in Africa. Such a practice permits Russia to enter Free World markets by the back door.

Soviet political influence invariably follows Soviet economic penetration. This philosophy can and will continue unless counteractive steps are taken.

At present, Western oil companies stay out of local politics, whereas, Russian state enterprise, by definition, represents a direct political arm of the Soviet Government. A developing country that trades its commodities for Russian oil and technological aid is leaving itself wide open to political infiltration.

Can Russia increase its oil exports? "... Khrushchev boasted to the Supreme Soviet in 1957 that in 15 years the USSR would be producing oil at an annual rate of 3 billion barrels, 500 million barrels more than U.S. production in 1960 (but not taking into account our productive capacity of nearly 4 billion barrels last year).

"They have the oil, they are producing in increasing quantities, and they have the advantage of utilizing all the techniques, instruments, and methods which the U.S. oil industry developed and perfected over a long period of years. Thus, the USSR has become the world's No. 2 oil producer.

"Along with production, the USSR has steadily built up an improved distribution system. This includes not merely tankers, but pipe lines as well. Pipe lines in place

oil exports over a prolonged period?

plus those planned for the next five years will provide service to East Germany and Poland, to Hungary and Czechoslovakia, to Turkey and Mongolia, in addition to seaport service to the Black Sea, Caspian Sea and Baltic Sea.

"Here, then, is an industry with limitless petroleum resources, increasing production facilities, using the very best techniques and an expanding distribution system which can and will be used as an effective instrument in the cold war."

The above statements, put into the Congressional Record on June 20, reflect the evaluations of Russia's export potential as seen through the eyes of our federal government, based on careful studies made by a number of government agencies.

Until recently, it was believed that lack of transport facilities would be a major deterrent to Russia's increasing role in the world oil market. This no longer is true. Russia's new pipe line system is well on the way. Tankers have been taken on barter arrangements from Greece. Italy, Japan and other Free World nations are building more tankers for Russia.

Only one deterrent to Russia's export plans remains, if the Free World does not take action. That is the consumption growth rate within the Soviet bloc. At present, the USSR is consuming about 2,150,000 barrels of crude oil daily. Gas consumption in oil equivalents is almost 30 percent of this volume. Should Russia's internal consumption start increasing at a rate that outpaces supply, which is highly unlikely in the near future, then the threat to Free World markets will be removed.

What about reserves? As one of the U.S. experts who recently returned from a tour of the Russian oil and gas fields put it:

"From our discussion with various people in the USSR who are associated with the oil and gas industry of the country, it became apparent that Soviet crude oil reserves are very large. The potential oil bearing area of the USSR is nearly twice that of the United States.

"At Stalingrad, the Soviets stated that explored reserves are in excess of 22 billion barrels, but they hastened to add that there are more than 100 discovery wells in new areas where reserves have not yet been fully measured, and that numerous potential oil-bearing areas remain yet to be explored.

"On several occasions the Soviets claimed the world's largest reserves. While we may doubt this claim, there is no doubt that the crude oil reserves of the USSR are large and it was evident that Soviet plans for the future development of the oil industry are based on such an assumption.

". . . There is every reason to believe that the Soviets will meet the goals of their Seven Year Plan. Perhaps even exceed it as they claim they will. If bottlenecks occur they are more likely to be in storage and distribution facilities."

H. A. Eddins, president of Oklahoma Natural Gas Company, upon his recent return from a tour of Russian gas installations reported that the Soviet gas industry is about 10 years behind U.S. methods and that production is about 15 percent of that in the United States. Only one underground storage reservoir was seen during the month-long tour.

These observations have been corroborated by several WORLD OIL sources. There is little doubt that Russia can achieve its 1959-1965 goals for production. And for exports, if Free World industry and government fail to take steps to curb them.

What can Free World do about it?

First, it must be recognized that the United States is doing a great deal now. U.S. oil and gas equipment manufacturers, the Export-Import Bank under its new policy, oil companies, and others are in many instances contributing much more to the economic growth of developing nations than is Russia—with no political or religious strings attached. The examples in the Middle East, in South America, Africa and elsewhere are too numerous to mention here.

Little recognition is given to these facts in government reports on the Russian oil offensive. But, our government is beginning to recognize the seriousness of the situation, and is just now taking some steps to curb the rush of Communist oil into Free World markets.

Following are some of the actions that have been suggested:

Interior Secretary Stewart Udall. Importers and potential importers of Soviet oil must consider the implications of dependence on this source in the event of military emergencies of any kind. The stakes in this area are high and the risks are great.

It is here that each nation must search its national conscience in an attempt to achieve a balance between the immediate advantages and the long term risks.

There must be closer cooperation between the domestic petroleum industry and the federal government, in coping with the Soviet oil issue and other problems with

which this department is concerned. Communications between the industry and government in the field of mobilization planning have become clogged in recent years. Discussions are now taking place within the Executive Branch to develop procedures which will permit the complete utilization of the immense knowledge of the oil and gas industry in this critical field.

Arthur H. Dean, Sullivan and Cromwell (attorneys), New York City. Our answer to this threat must be supplied by the private oil companies of the Free World. No one, I think, would have our government take over the job of meeting Soviet bloc competition by becoming a state trader.

Gordon W. Reed, Board Chairman of Texas Gulf Producing Company. Though it may not be practical to eliminate or cut back sharply Russian exports to Free World markets, it may well be possible to keep the present rate of exports from increasing. One method would be for each Free World nation to hold its Russian imports at their current levels. In short, set up an economic NATO among the Free nations.

Eliot Janeway, President, Janeway Research, Inc. The problem is so big, and the need for a solution is so urgent that any workable answer must be simple. To fight Soviet fire with fire—by bartering Free World oil—is as simple a solution as it would be comprehensive and effective.

Barter has been the main weapon of the Soviet economic offensive. There is no reason why we cannot mobilize it as a weapon in the counter-offensive. We can make use of our surplus commodities on a limited and reciprocal barter basis instead of financing giveaway and "soft" loans with dollars and taking payment in soft currencies.

If we should extend oil credits to countries into which we are now funneling foreign aid cash, we would slow down our dollar outflow, while at the same time speeding up the free and world-wide movement of commodities. We would also be using our foreign aid to raise what economists call "effective demand"—meaning the purchasing power of people who want petroleum products. This would put a prop under world crude prices, thereby helping ourselves and every other Free World oil producing nation and frustrating the prime objectives of Soviet policy.

Just because it is important to the Soviets to devalue oil, it is important to us to stabilize those prices as a prerequisite to stabilizing free economic societies.

A condition for the extension of such oil credits would be that they be used only to buy products from certain specified supply points. We need not figure prominently or at all as vendors. The problem for U.S. foreign economic policy and for the U.S. oil industry is to find a solvent market outside the U.S. for Free World productive capacity—in particular, the capacity of such countries as Venezuela where there are heavy American investments in supplies, equipment and personnel, and where the oil depression is increasing the threat of "Castroization."

A counter-offensive such as this will stop Red raiding of the strategic petroleum industry, while freeing purchasing power in the importing nations. Holding the line, economically, in turn will automatically build solid social lines of defense against the Soviet political offensive.

George Getty, President, Tidewater Oil Company. Untie some of the federal government's antitrust shackles and allow private companies to coordinate defense measures and exchange ideas with Free World governments.

These are some of the suggestions that have been offered to keep Russia from achieving its Cold War goals. There are many others. Most of them have merit.

All that remains is to provide a means of assimilating these ideas, use them to formulate a single plan to be carried out by industry and government, then put that plan into effective action.

Let's not wait until it is too late.

What's happening in the oil a

Drilling activity was up 3 percent for the year in Texas by mid-August with 11,097 wells drilled through the 12th, compared with 10,773 during same 1960 period—search for gas continues to increase sharply with 1,877 new gas completions reported through August 12, up 684 wells or 57.3 percent over same 1960 period; while 5,767 new crude oil producers were reported, down 366 wells or 6.3 percent from same 1960 period . . . Activity is picking up in West Virginia, following discovery of rich gas field in Pocahontas County, with some wells making up to 50 MMcf gas per day from 8,200 feet in Oriskany sandstone . . . Yemen's first and second wells are being drilled by John W. Mecom, with 5,000-10,000 foot targets on peninsula on Red Sea. Mecom has 6.4 million acre concession in the area with 5-year exploratory rights and 30 years for development . . . The Royal Dutch Shell Group and Jersey Standard will drill offshore wildcat in North Sea about 2½ miles from Holland coast near Kijkduin, with projected depth of 6,500 feet . . . Drilling in Michigan's 35-mile long Albion-Scipio trend has slowed down, with only 3 new producers completed during June, bringing field total to 370 . . . Six wells were drilled in Florida during first half of 1961, all dry holes . . . Holding Rodio S. A. of Zurich, Switzerland is studying possibility of carrying out an important drilling campaign in the High Alps next winter . . . Almost one out of every six wells

NATIONAL DEFENSE:

Plenty of oil for a national emergency

WHILE THE FUROR continues over issue of "to be or not to be" concerning oil imports, this statement has just been issued:

In the event of a national emergency, the government would need no new machinery to handle military demands for oil products, including jet fuels. Existing authority could handle oil distribution problems as well as military needs.

Independent Petroleum Association of America says U.S. crude oil output could be increased 3 million barrels daily, to about 10 million barrels daily on short notice. Petroleum product stocks are high and could be drawn upon while production and refining operations are being accelerated.

IPAA is actively opposed to pro-imports spokesmen who say the United States must have oil from outside sources now so we can be insured of having enough during times of crisis.

CAPITAL OUTLAYS:

Oil industry increases overseas equipment budget

THE PETROLEUM INDUSTRY reports a sharp upturn in projected capital outlays for plant and equipment used abroad during 1961. Total is expected to be $1.76 billion, up nearly 20 percent over $1.3 billion spent during 1960.

The peak outlay was $2.3 billion in 1957.

Continuing a shift already evident in previous years, the new expenditures emphasize the development of new producing areas in North Africa, and of improved refining and distribution facilities in Europe. Scheduled plant and equipment expenditures of U.S. oil companies in the Eastern Hemisphere will be up about one-third in 1961, while investments in the Western Hemisphere will increase by less than 10 percent.

For the past several years, the U.S. petroleum industry has been the largest investor in plant and equipment abroad. This year, petroleum will account for 40 percent of the $4.5 billion all-industry total, while manufacturing accounts for just slightly less, and mining and smelting for the remainder.

Projections for 1962 show the petroleum industry will be the only major category to increase its investments, with an expected $1.79 billion. Both the all-manufacturing and mining and smelting categories are expected to show decreases next year.

PRORATION:

Texas may take action on disproportionate output rates

Two new devolopments may force action in states which are said to have oil production rates out of proportion to reserves.

1. Interstate Oil Compact Commission may bring matter to a head at its September 29 Executive Committee meeting in Biloxi, Mississippi. The newly formed Committee on Equalization of the Oil Market for Producing States is expected to be ready to make its first report at this session.

2. A bill has been introduced in the Texas Legislature which would set the state's allowable at not less than the state's proportionate share of U.S. crude oil reserves. Although the production rate could be adjusted 5 percent to meet market demand, it could not be set below the June 1961 production rate. New ruling would force the

...as country

completed in the Rocky Mountains so far this year has been spudded in six southwest Nebraska counties, more than 60 percent of Nebraska's 1961 drilling has been in the Cambridge Arch area . . . 300 billion barrels of oil said to exist in 30,000 acres of tar sands along Alberta, Canada's Athabasca River may soon be felt in the U.S.-Canadian markets; Cities Service, et al say 3,000 barrels per day pilot plant is technical-economic success. Plans now are to expand operation to full scale commercial production, with initial goal of 100,000 barrels of tar sand oil daily . . . Pure Oil has been granted 15,900-acre exploration concession in Honduras, with seismic operations to start in October; only one dry hole has ever been drilled in the Honduras . . . India will pay costs and French Petroleum Institute will provide technical advice in exploration program slated for India's Jaisalmer area of Rajsthan State . . . Look for Bureau of Land Management to issue invitations to bid for oil and gas leases in two government helium reserve areas in Utah shortly; order has been signed allowing for oil and gas leases in Reserve area 1 near Woodside and Reserve area 2 near Cisco . . . H.H.&R. Driling Company, Wichita Falls, Texas, will drill 25 exploratory tests on Continental Oil's leases in Pike and Scioto counties, southern Ohio . . . Colombian Petroleum reports wildcat drilled five miles southeast of Cicuco in north-central Colombia is producing 348 barrels of 14° gravity crude daily through 3/16-inch choke at 8,084 feet; nearby Cicuco field, discovered in 1956, is producing about 25,000 barrels of crude daily.

Texas Railroad Commission to raise the allowable from the current 8 days, to about 12 days.

The Texas action was based on reports that the state has about 46 percent of U.S. crude reserves, but is producing only about 36 percent of the total.

TAXES:

Change in 'A.B.C.' tax would hurt small operator

THE INTERNAL REVENUE SERVICE is studying tax procedures on profits from "A.B.C." transactions of oil properties—with eye toward changing the method so that such transactions will be taxed on ordinary income basis.

If this happens, following may result:

- Oil and gas leases will be seriously devalued, resulting in an unfair disadvantage to operators, land owners, royalty owners, banks, and state taxing authorities.
- Oil and gas leases will fast become hot potatoes—will be put up for sale on a grand scale.
- Federal government itself will immediately suffer revenue loss.

Although proposed change is said to be directed at big business, the small operator also will be hard hit. Large integrated companies seldom sell, and even when they do they have many sources of depreciation against which to charge the income tax. There is no such advantage for small operator. He will be faced with ruling that would make it difficult if not impossible for him to realize capital gain upon retirement.

Internal Revenue Service will not make policy change for several months. Independent operators had until August 31 to file comments or objections, after which a government-industry conference will follow.

SOCIALISM:

ENI says private companies will fade from world scene

Paying little attention to the role private competition has played in the rapid uplifting of civilization, Italy's government-owned oil monopoly ENI has lashed out against international oil companies.

In a study of 50 years of oil, ENI says oil empires for private gain are over. Instead, a well-run public company with "public interest" (or graft) at heart instead of profits is taking their place.

According to ENI, today's big oil companies are a major obstacle to economic equilbrium. Profits of "40-45 percent" made by companies in the Middle East are holding back the law of supply and demand.

Another case of butchering the truth to justify suppression of free enterprise, destruction of individual initiative and freedom of consumer choice.

Viewpoints

"For those who like to maintain that Texas' tremendous losses in the domestic crude market is a thing of the past, that our five-year skid ended in 1960, and that the future will be brighter 'if we don't rock the boat now,' newly released data for the first half of 1961 provide a severe jolt. The downward slide continues uninterrupted.

"The cold facts are these: In the first six months of 1961 Texas production dropped 2 million barrels below 1960 levels for the same period, while other states increased their production by 31.6 million barrels. Imports —even under stricter controls—increased 4 million barrels. During this same period, total demand decreased by 16.7 million barrels and stocks rose 31 million barrels."

James F. West, President Texas Independent Producers and Royalty Owners Association

"One thing is certain, neither the oil industry's nor the coal industry's problems have been solved, or even much eased, by 15 months of import restrictions. This is not an argument against restrictions. But it does indicate that the failure of oil and coal production to rise is obviously due, to a very large extent, to causes other than displacement by oil imports."

John H. Lichtblau, Petroleum Industry Research Foundation

". . . For the last 20 years most of the management decisions made in our industry have been predicated on operating considerations . . . that is, methods and tools. Current decisions must, however, be based primarily upon far different considerations . . . mostly upon costs and return on investment . . . in short, economics. Unfortunately, we are only now beginning to face up to the economic facts of life in our industry . . . and the reflection we see is often not a pretty picture."

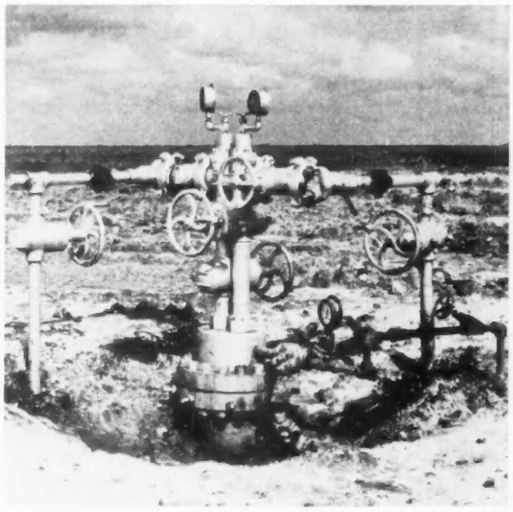
L. F. McCollum, President, Continental Oil Company

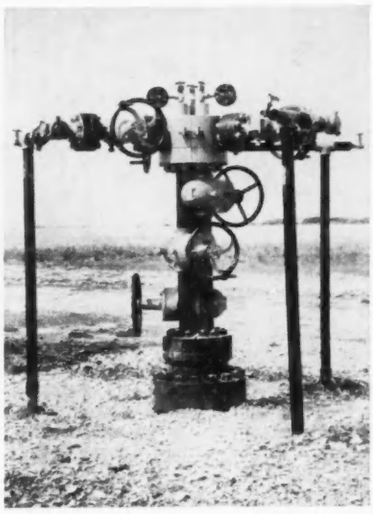
"Businessmen are only too often antagonistic toward government—and equally, those in government have found it politically useful to harass business. Our primary problems are now global in scope. They are altogether too vast for government or business corporations to resolve alone. To meet the demands for the cold war, clearly a working partnership between business and labor and government is needed."

M. J. Rathbone, President, Standard Oil Company New Jersey

". . . The decision as to when the Mohole will be drilled awaits the complete evaluation of the data just collected in drilling tests, the design and construction of the ultimate drilling vessel and the resolution of the problems facing the Panel on Site Selection. The decisions may come this year. Financing and construction of the drilling vessel may take considerably longer."

W. A. Roberts, member of panel on drilling technique, AMSOC Committee, National Academy of Science.





Part 2: Casing Programs and Primary Cementing Equipment

Small diameter well completions

By R. W. Scott, Engineering Editor, WORLD OIL

MANY DIFFERENT CASING PROGRAMS have been designed for small diameter wells. This section of Engineering Practices Report No. 4 presents general types which have been used successfully. In several cases, programs were designed for requirements of a specific area, and it is not intended that each type discussed be considered applicable to all areas of operation.

Surface casing. The designing and running of surface casing strings for small diameter wells have embodied no significant changes from conventional practices. Operators have tended to use casing on hand for this purpose, resulting in many odd sizes of surface pipe being used on comparable small diameter completions.

In some areas, surface casing has been set to shallower depths than normal in an effort to achieve further cost reductions. In such cases, conservation rules are met by spotting cement opposite any fresh water sands which occur beneath the surface casing shoe. Usually, slurry is displaced through 1-inch pipe run through an extra hole in the oil string casing hanger and parallel to the oil string(s).

Table 9 shows sizes of surface casing generally used in small diameter wells.

Some combination surface strings have been installed in quadruple string completions to accommodate the 12-inch blowout preventer hookups required to pass quadruple hanger equipment. A single joint of 13⅜-inch casing is run on top of a string of 10¾-inch pipe. The larger topmost joint permits installation of 12-inch preventers and facilitates installation of the large casing hanger.

Use of combination (10-inch x 12-inch) casing heads now has made this practice optional.

Oil string casing. Many different sizes and types of casing have been used in small diameter wells, including 2⅜-inch OD line pipe and tubing; 2⅞-inch OD line pipe and tubing; 3½-inch OD line pipe and tubing; and 4½-inch drill pipe. However, most completions have been cased with either 2⅞-inch OD EUE or Regular API tubing. Because of this, the remainder of the report will be confined to discussion of operations with 2⅞-inch pipe.

In some areas, there is a growing tendency to use 3½-inch OD casing and in some cases 2⅜-inch casing, depending on the specific application. However, these jobs are far fewer in number than operations with 2⅞-inch pipe.

In most cases, 2⅞-inch casing programs are over-

TABLE 9—Surface casing-oil string relationship in small diameter wells.

Type Well	Oil String(s)	Surface Casing
Single	2⅜	5½
	2⅞	7, 7⅝ or 8⅝
Dual	2—2⅞	8⅝
Triple	3—2⅞	9⅝
Quadruple	4—2⅞	10¾

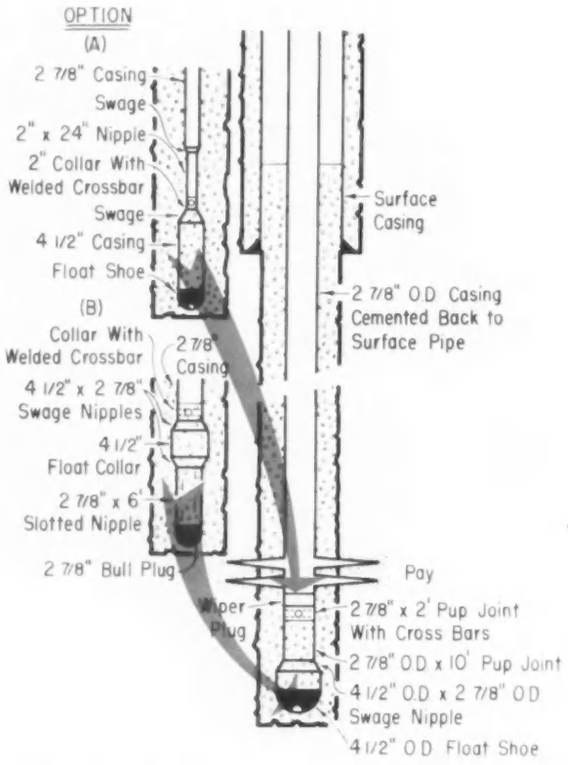


FIGURE 7—Single string small diameter wells with oversize cementing equipment.

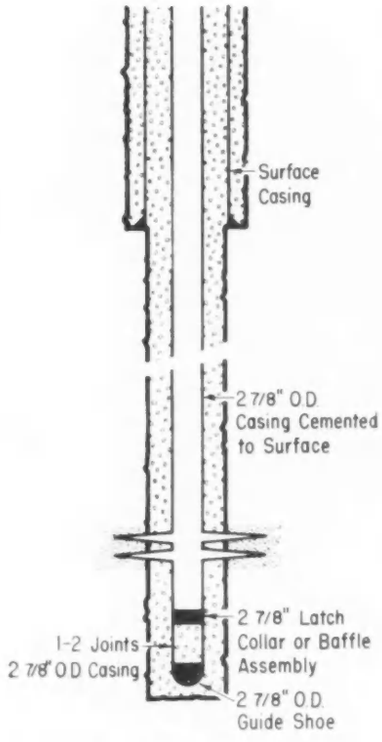

Surface Casing
2 7/8" O.D. Casing Cemented to Surface
2 7/8" Latch Collar or Baffle Assembly
1-2 Joints 2 7/8" O.D. Casing
2 7/8" O.D. Guide Shoe

FIGURE 8—Single string small diameter well with latch type cementing equipment.

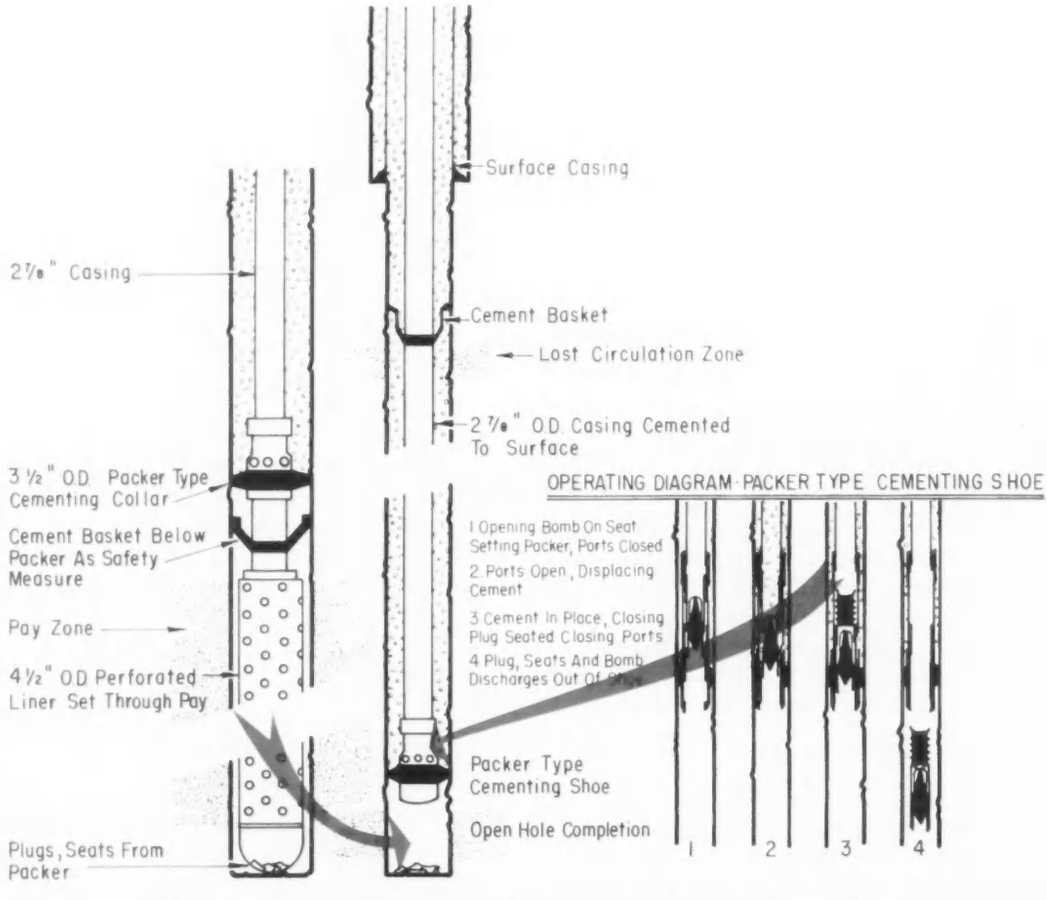

Surface Casing
2 7/8" Casing
Cement Basket
Lost Circulation Zone
2 7/8" O.D. Casing Cemented To Surface
3 1/2" O.D. Packer Type Cementing Collar
Cement Basket Below Packer As Safety Measure
Pay Zone
4 1/2" O.D. Perforated Liner Set Through Pay
Plugs, Seats From Packer
OPERATING DIAGRAM-PACKER TYPE CEMENTING SHOE
1 Opening Bomb On Seat Setting Packer, Ports Closed
2 Ports Open, Displacing Cement
3 Cement In Place, Closing Plug Seated Closing Ports
4 Plug, Seats And Bomb Discharges Out Of Shoe
Packer Type Cementing Shoe
Open Hole Completion
1
2
3
4

FIGURE 9—Single string small diameter well—open hole completion.

designed when compared to normal procedures. The additional burst strength available, however, is advantageous because of high stimulation and squeeze pressures normally encountered in small cased wells.

SINGLE COMPLETIONS

Many types of small diameter single string casing designs have been used successfully. Since these installations have been developed on an area basis and operator preferences, several are included for consideration.

Differences in hook-ups consist chiefly of placement and types of downhole cementing equipment. As might be expected, the present trend is toward simplified, full-open type installations.

Some installations discussed were early efforts in the field of small diameter well completions. Although modifications may be in order, these have been used successfully and remain equally applicable now as when developed.

It is common practice to extend casing strings from 50-100 feet below the lower-most productive interval to eliminate the need of drilling out cement and to provide adequate rat hole for perforating gun debris, junk, etc. Most operators feel it is cheaper (and less risky) to drill and case the extra hole than to undertake drill-out operations with macaroni tubing in the small ID pipe.

Both mechanical and magnetic landing nipples are used in many areas to facilitate workover by wireline methods. Since placement may vary according to preference, specific positions are not indicated on the following designs.

Installation No. 1—Pumping Oil Well, Figure 7.

1. 4½-inch float shoe.
2. 4½-inch x 2⅞-inch swage nipple.
3. 2⅞-inch OD x 10-foot pup joint.
4. 2⅞-inch OD x 2-foot pup joint with steel cross bars welded inside.
5. Centralizers installed as follows: One on 10-foot pup joint, one on next joint, two at 90-foot spacing, two at 300-foot spacing.
6. Scratchers used as follows: Two on 10-foot pup joint, three on next joint, four at 15-foot spacing.
7. 2⅞-inch OD tubing to surface.

The 4½-inch float shoe is used because it provides additional port area for circulating and displacing cement; offers a centralizing effect in the 6¼-inch hole; and automatically prevents back flow of cement. The increased area provided in the oversize shoe miniminzes cutting action during circulation periods.

Cross bars welded in the 2-foot pup joint provide a positive seat for the cement wiper plug. Laboratory tests have shown that the plug and bar arrangement will withstand pressures to 4,000 psi without leakage. Plugs have been passed through pump seating nipples with little increase in pressure.

Option "A"—Figure 7:

1. 4½-inch OD float shoe.
2. One short joint (6-30 foot) 4½-inch OD casing.
3. 4½-inch OD x 2⅜-inch OD swage nipple.
4. 2⅜-inch OD x 2-foot nipple.
5. 2⅜-inch nipple with steel cross bar welded inside.
6. 2⅞-inch OD x 2⅜-inch OD swage nipple.
7. Centralizers installed every 200 feet.
8. Scratchers installed on each joint through pay zone.
9. 2⅞-inch OD casing to surface.

As in the original installation, 4½-inch equipment is used because of increased port area which is less susceptible to cutting and plugging from lost circulation material than smaller equipment. The 2⅜-inch OD section provides a seat for the wiper plug. Since the plug is designed for 2⅞-inch OD casing, it is squeezed into place in the 2-inch nipple and seated on the cross bar, thus providing an effective seal.

Option "B"—Figure 7:

1. 2⅞-inch OD bull plug and collar.
2. 2⅞-inch OD x 6-foot slotted nipple.
3. 4½-inch OD x 2⅞-inch OD swage nipple.
4. 4½-inch OD float collar.
5. 4½-inch OD x 2⅞-inch OD swage nipple.
6. 2⅞-inch OD collar with cross bar welded inside.
7. Centralizers and scratchers through pay zone.
8. 2⅞-inch OD casing to surface.

Installation No. 2—Figure 8.

1. 2⅞-inch OD guide shoe (option: with or without pump out nose).
2. One or two joints 2⅞-inch OD casing.
3. 2⅞-inch OD plug landing (latch) collar, or baffle assembly installed in conventional collar.
4. Centralizers installed from bottom to 200 feet above top pay; scratchers through zone of interest.
5. 2⅞-inch OD casing to surface.

Newer types of 2⅞-inch guide shoes are constructed with larger port areas, and permit adequate circulation and displacement rates. Operators consider open guide shoe installations advantageous since pipe does not have to be filled while running.

Latch type landing collars and baffle assemblies have proven excellent back pressure devices as well as offering good circulating rates without providing restrictions.

Installation No. 3—Open Hole Completion, Figure 9.

1. Packer type cementing shoe with 2⅞-inch connection.
2. Centralizers to 200 feet above top pay; scratchers installed through upper pay zone.
3. 2⅞-inch OD casing to surface with cement baskets spaced above possible lost circulation zones.

Use of the packer type shoe allows operator to set on top of pay. Opening bomb seats packer element, prevents circulation around bottom of shoe and opens cementing sleeve, allowing displacement of slurry into annulus. Closing plug closes sleeve and is pumped out of bottom of shoe with opening bomb and seats, thus, providing a complete job without the necessity of drilling out cement.

Option "A"—Figure 9:

In some cases, it is desirable to set a perforated or slotted liner through the productive interval instead of

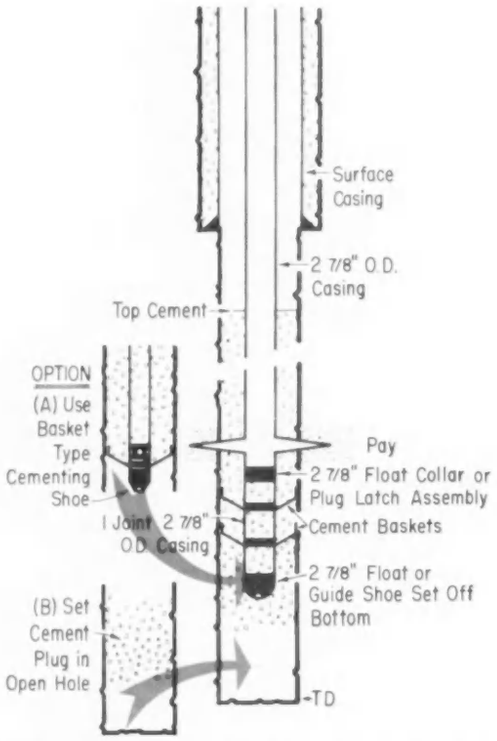

Surface Casing
2 7/8" O.D. Casing
Top Cement
OPTION
(A) Use Basket Type Cementing Shoe
Pay
2 7/8" Float Collar or Plug Latch Assembly
1 Joint 2 7/8" O.D. Casing
Cement Baskets
2 7/8" Float or Guide Shoe Set Off Bottom
(B) Set Cement Plug in Open Hole
TD

FIGURE 10—Single string small diameter well—pipe set off bottom.

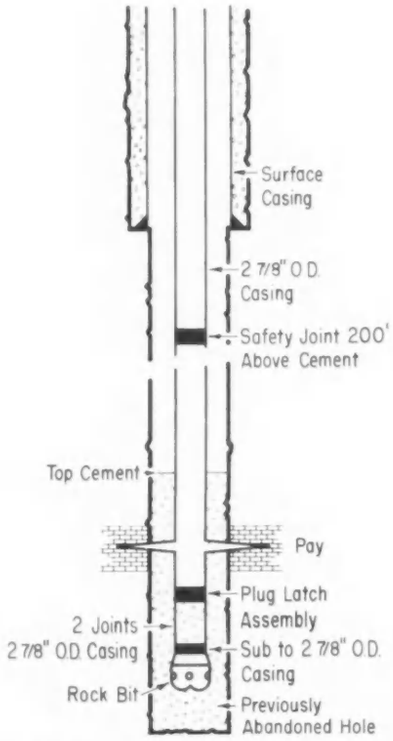


FIGURE 11—Single string small diameter well—casing program for old, previously drilled holes.

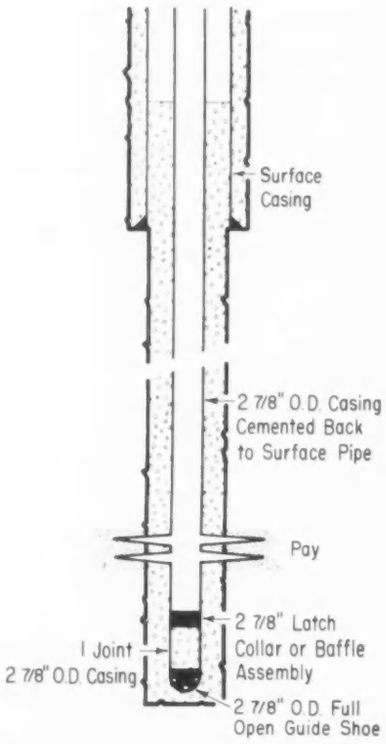

Surface Casing
2 7/8" O.D. Casing Cemented Back to Surface Pipe
Pay
2 7/8" Latch Collar or Baffle Assembly
1 Joint 2 7/8" O.D. Casing
2 7/8" O.D. Full Open Guide Shoe

FIGURE 12—Single string small diameter well—general program.

producing the well through the open hole section below the packer. The hookup then is revised as follows:

1. 4½-inch OD bull plug.

2. 4½-inch OD perforated liner set through productive zone.

3. 4½-inch OD x 3½-inch OD sub.

4. 3½-inch OD nipple with cement basket. (Used as safety measure if packer should fail.)

5. 3½-inch OD packer type cementing collar.

6. 3½-inch OD x 2⅞-inch OD sub.

7. 2⅞-inch OD casing to surface.

Installation No. 4—Pipe Not Set On Bottom, Figure 10.

1. 2⅞-inch OD float or guide shoe (optional installations utilize basket type cementing shoe or cement plug).

2. One joint 2⅞-inch OD casing with cement baskets.

3. 2⅞-inch OD float collar or plug latch type assembly (not used if basket shoe run).

4. Centralizers to 200 feet above pay zone; scratchers through pay zone.

5. 2⅞-inch OD casing to surface.

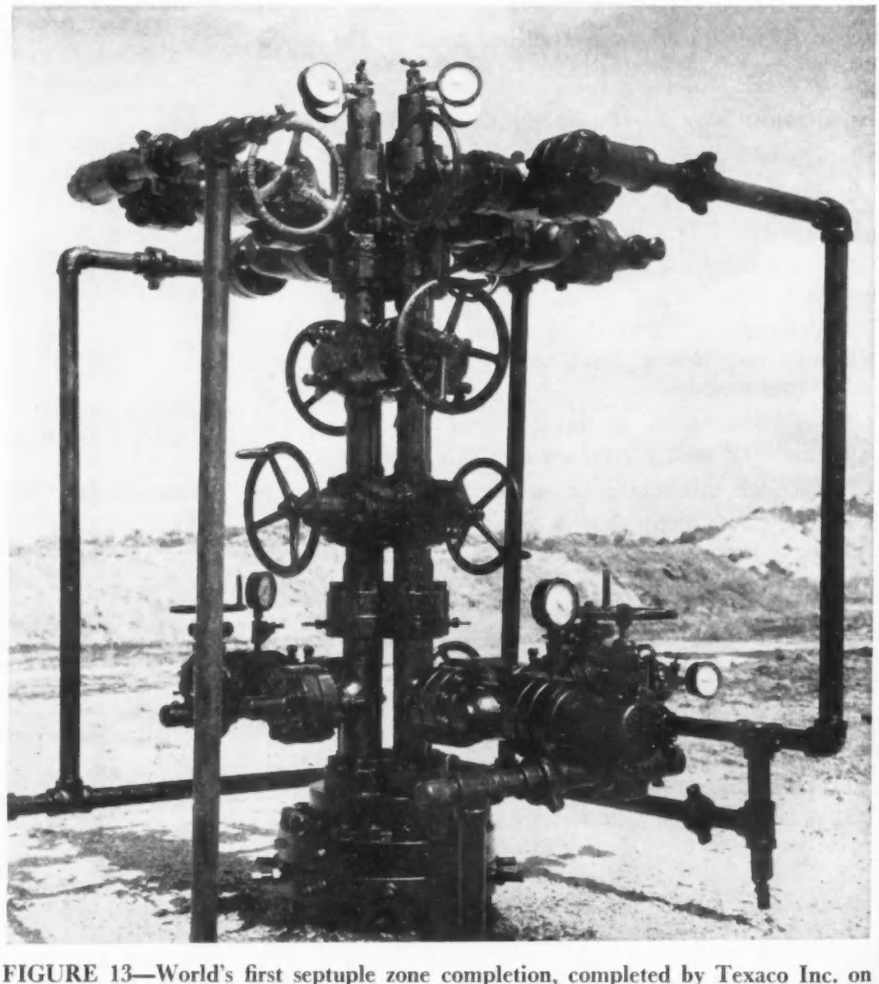


FIGURE 13—World's first septuple zone completion, completed by Texaco Inc. on Texas Gulf Coast, is equipped with quadruple strings of 2⅞-inch casing, three of which are completed concentrically.

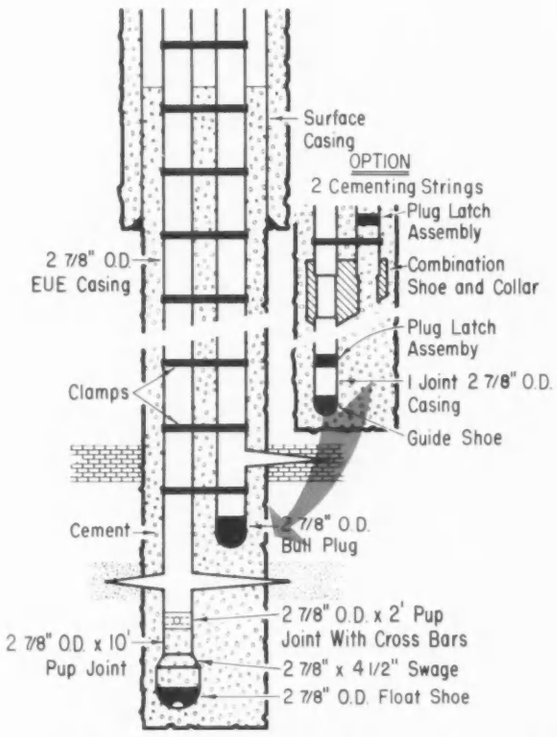

Surface Casing
OPTION
2 Cementing Strings
Plug Latch Assembly
2 7/8" O.D. EUE Casing
Combination Shoe and Collar
Plug Latch Assemby
Clamps
1 Joint 2 7/8" O.D. Casing
Guide Shoe
Cement
2 7/8" O.D. Bull Plug
2 7/8" O.D. x 2' Pup Joint With Cross Bars
2 7/8" O.D. x 10' Pup Joint
2 7/8" x 4 1/2" Swage
2 7/8" O.D. Float Shoe

FIGURE 14—Dual parallel string small diameter well completion—clamped installation with oversize equipment.

Use of the cement baskets or basket shoe prevents slurry from falling to bottom during and after the cementing operation. In some cases, cement plugs have been spotted in open hole for the same purpose.

Installation No. 5—Hookup for Cleanout and Completion of Old Wells. Figure 11.

1. Salvage rock bit (size dependent on diameter of hole being cleaned out).
2. Sub to 2⅞-inch OD casing.
3. 2-joints 2⅞-inch OD casing.
4. 2⅞-inch plug latch assembly.
5. 2⅞-inch OD casing to point 200 feet above anticipated top of cement in annulus.
6. 2⅞-inch OD safety joint.
7. 2⅞-inch OD casing to surface.

Hole is cleaned out to bottom and entire assembly is cemented in place. If well is dry, pipe can be backed off at safety joint and recovered. Chief advantage of this technique is that an extra trip does not have to be made once hole is cleaned out to bottom.

Installation No. 6—General, Figure 12.

This design has resulted from information compiled from many operators and may be considered applicable in most operational areas with the following qualifications:

1. Mud is required for well control.
2. Cement can be displaced into surface pipe without lost circulation difficulties.
3. Pipe is set-through productive interval.

Design is as follows:

1. 2⅞-inch OD full open guide shoe.
2. One joint 2⅞-inch OD casing.
3. 2⅞-inch OD latch collar or baffle assembly.
4. Centralizers or turbulizers spaced to 100 feet above top pay zone (one per joint), and through water bearing sands.
5. Scratchers spaced through pay zone (two per joint).
6. 2⅞-inch OD casing to surface.

If the well is completed on a water location, a landing nipple and flow coupling should be installed below the greatest anticipated swabbing depth. The nipple will serve as a seat for storm chokes or other wireline tools. Also, if the well is to be pumped, a seating or landing nipple may be installed in the string at the appropriate depth.

The upper portion of the string (1,500-2,500 feet) may be plastic coated if paraffin is a problem and well fluids are to be produced through the casing proper. If corrosion is anticipated, the entire casing string may be plastic coated.

If lost circulation troubles are anticipated, cement baskets and multiple stage cementers may be spaced at appropriate intervals on the casing string.

MULTIPLE PARALLEL STRING COMPLETIONS

Currently, multiple small diameter well completions have been made using two, three and four strings of 2⅞-inch OD EUE and/or regular casing. Quintuple string hanger equipment is available, and it is likely that a five-string installation will be completed as soon as a favorable sequence of reservoirs is found. This, of course, would mean that a 10-zone producer would be possible if each casing string were completed concentrically.

As of mid-July 1961, the record for the most zones completed in a single well bore was held by a Texaco Incorporated multiple small diameter string well on the Texas Gulf Coast (See Figure 13). This 8,500-foot completion is equipped to produce from seven reservoirs through four strings of small casing, three of which are completed concentrically.

Small diameter casing strings also are commonly run in conjunction with larger oil strings (2⅞-with 4½, etc.). Obviously, many such combinations are possible.

The primary consideration in designing multiple string installations has been whether to run all strings to approximately the same depth. The answer normally is dictated by economics, type casing program design and flexibility needed for future work. For example, if one string of a multiple is junked and all strings are run to bottom, a concentric dual completion can be made in a companion string to open the reservoir which normally would have been produced through the junked string.

Presently, many operators feel that chances for a successful cement job also are increased if all strings are run to approximately the same depth. As in most cases in small diameter well operations, the question is one which must be resolved from experience in the area of operation.

Regardless of the depth positioning of casing strings in relation to one another, each should be set at least 50-100 feet below the zone which will produce through it. If the long string is not set on the bottom of the hole, it is good practice to install cement baskets on the lower portion of the string or to use a basket type cementing

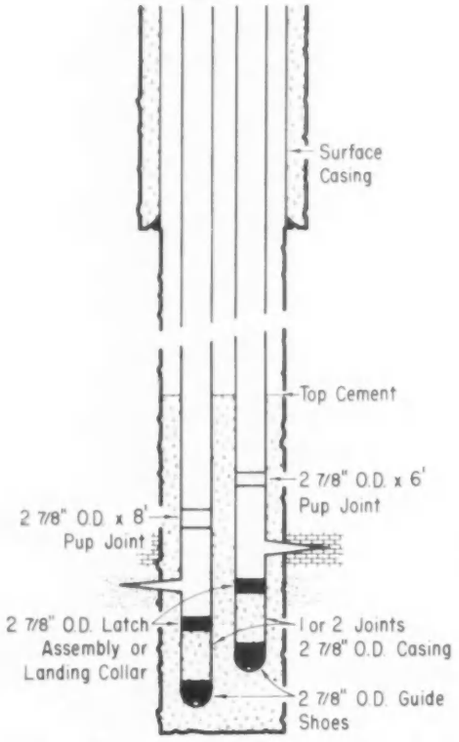

Surface Casing
Top Cement
2 7/8" O.D. x 6' Pup Joint
2 7/8" O.D. x 8' Pup Joint
2 7/8" O.D. Latch Assembly or Landing Collar
1 or 2 Joints 2 7/8" O.D. Casing
2 7/8" O.D. Guide Shoes

FIGURE 15—Dual parallel string small diameter well completion—twin cementing string hookup with latch type cementing equipment.

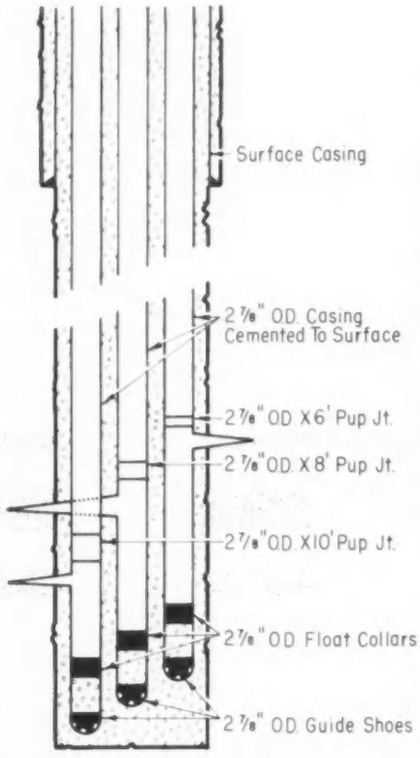

Surface Casing
2 7/8" OD. Casing Cemented To Surface
2 7/8" OD X 6' Pup Jt.
2 7/8" OD X 8' Pup Jt.
2 7/8" OD X 10' Pup Jt.
2 7/8" OD Float Collars
2 7/8" OD Guide Shoes

FIGURE 16—Triple parallel string small diameter well completion—program for displacing cement through all strings.

shoe. This equipment will prevent fall-back of cement into the rat hole and will prevent mud contamination of slurry around the casing shoe. The long string would be equipped as in the single installation shown in Figure 10.

Initially, strings were designed to be run concurrently with the short string clamped as a parasite on the long string. Each pipe clamp thus supported the length of tubing between it and the next clamp. However, this method proved both costly and time consuming. Development of multiple string slips and elevators now enable operators, if they desire, to run strings concurrently without clamps.

As a point of interest, cement jobs obtained on the clamped installations were generally good, apparently because of the optimum pipe separation provided by the clamps.

Recent practice has been to run multiple strings separately or one at a time. Couplings are turned down on top to facilitate pipe passage in the hole. New centralizers and spacer equipment also have aided in this respect. However, considerable pipe twisting has been indicated in many instances when the individual installation method has been used.

Normally, strings are provided with approximately the same type down hole tools as those used in single wells, and strings are run in a manner similar to single completions. Since practices vary widely in positioning of landing nipples, pump seating nipples, etc., these again will be omitted from discussion.

Installations incorporating mechanical orientation devices for perforating guns are not now in common use and are not included in the following programs. Since development of the radioactivity type orientation devices, the practice has been made obsolete and is not now in general use.

Casing programs given in the following section have been developed through experience and have been found to provide satisfactory cementing results. Since many variations of these designs are possible, several optional hookups are presented with each installation discussion.

Installation No. 1—Dual clamped string completion with one string set off bottom, cement displaced through long string, Figure 14.

Design from bottom up:

Long string

1. 4½-inch float shoe.

2. 4½-inch x 2⅞-inch swage nipple.

3. 2⅞-inch OD x 10-foot pup joint.

4. 2⅞-inch OD x 2-foot pup joint with cross bars welded inside.

5. 2⅞-inch OD tubing to surface.

6. Centralizers: One on 10-foot pup joint, two at 90-foot spacing, two at 300-foot spacing. Scratchers: Two on 10-foot pup joint, three on next joint, remainder at 15-foot spacing through pay zones.

Short string

1. 2⅞-inch OD bull plug.

2. 2⅞-inch OD tubing to surface clamped to long string at 300-foot intervals.

3. Centralizers (on dual portion of string): one on bottom joint of short string, two at 100-foot spacing. Scratchers: four on bottom joint, required number spaced at 15-foot intervals through pay zones covered by both strings of pipe.

Variations include use of a combination shoe collar (see drawing) instead of bull plugging the short string. In this manner, cement can be displaced through both strings. Triple string wells can be run in the same manner with cement displaced through one, two or three strings as desired.

Installation No. 2—Dual string completion with both strings run to approximately the same depth, cement displaced through both strings to some point above pay zone, Figure 15.

Design from bottom up for both strings:

1. 2⅞-inch OD guide shoe.

2. One or two joints 2⅞-inch OD casing with plug latch assembly in appropriate collar, or latch collar.

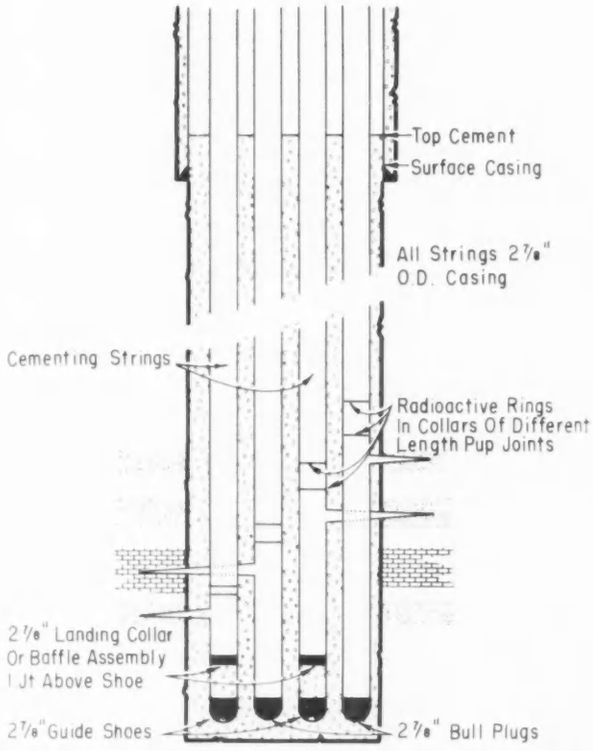


FIGURE 17—Quadruple parallel string small diameter well completion—cement displaced through two strings only.

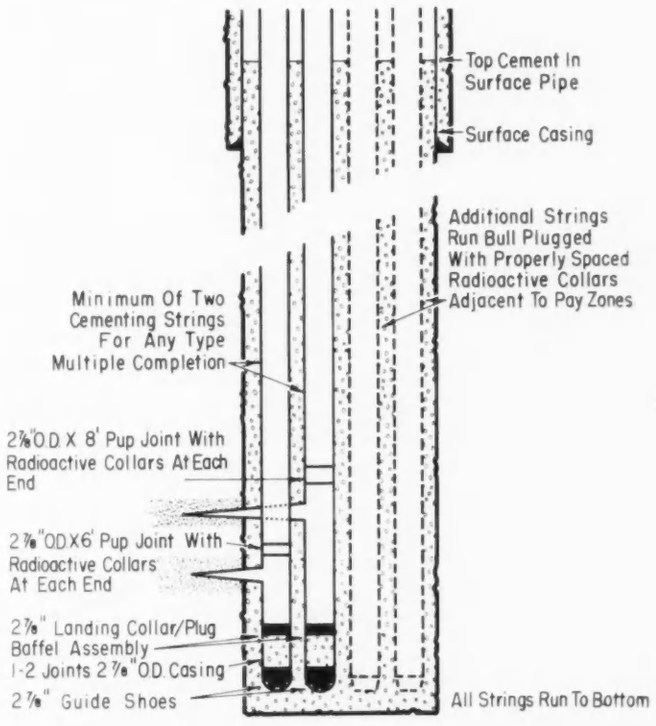


FIGURE 18—General program for parallel string small diameter well completions.

3. 2⅞-inch OD casing to point 30-feet above respective pay zones.

4. 2⅞-inch OD x 6-foot pup joint in short string, 2⅞-inch OD x 8-foot pup joint in long string.

5. 2⅞-inch OD casing to surface.

6. Centralizers or turbulizers: Option A—two per joint on alternate joints from shoe to 60 feet above pay zone. One per joint for next 200 feet. Option B—One per joint to approximately 200 feet above top pay.

7. Scratchers: Option A—none. Option B—One per joint (Staggered on each string) through pay zones.

Pup joints are used for depth correlation purposes while perforating. A minimum 6-foot length is used to simplify indentification.

Similar installations can be made for triple and quadruple wells except extra strings are not equipped with latch collars and are bull plugged on bottom. If additional strings are run, pup joints of different lengths are installed in each as mentioned previously.

Installation No. 3—Triple string completion, cement displaced through three strings to surface, Figure 16.

Design from bottom up for all three strings:

1. 2⅞-inch OD guide shoe.
2. One joint 2⅞-inch OD casing.
3. 2⅞-inch OD float collar.
4. 2⅞-inch OD casing to surface with pup joints spaced above pay zones.
5. Centralizers or turbulizers:

Option A—One every third joint of each string to 200 feet above top pay zone.
Final design of this type results in staggered pattern.

Option B—one per joint per string (staggered in relation to each other) to 200 feet above top pay.

Installation No. 4—Quadruple string completion, cement displaced through two strings only, Figure 17.

Design from bottom up:

Cementing strings (two)

1. 2⅞-inch OD guide shoe.
2. One joint 2⅞-inch OD casing.
3. 2⅞-inch OD latch type landing collar or baffle assembly.
4. 2⅞-inch OD casing to surface.

Other strings

1. 2⅞-inch OD bull plug.
2. 2⅞-inch OD casing to surface.

Radioactive rings installed in collars on each end of different length pup joints (Minimum length: 6-feet) in each string used for perforation depth control.

Centralizers or turbulizers: One per joint on cementing strings back to surface pipe. None on other strings.

Scratchers: Option A—None. Option—one per joint through pay zone and water bearing zones.

Same type of installation applicable to dual and triple completions. Two strings always utilized for cement placement. On duals, centralizers used on every joint of one string only. On triples, centralizers on every joint of two strings as above.

Installation No. 5—General, Figure 18.

This casing program has been applied extensively to dual, triple and quadruple completions with good results.

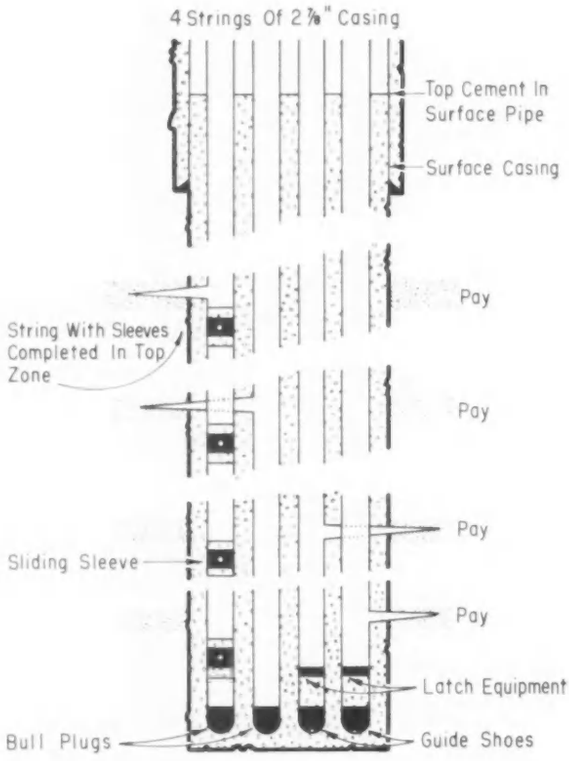


FIGURE 19—Parallel string small diameter well completion for difficult cementing areas.

Basically, it is a compilation of the experience of several operators who have made great strides in improving cement jobs success ratios on multiple string completions.

Design from bottom up:

Cementing strings (two)

1. 2⅞-inch OD guide shoe.
2. One or two joints 2⅞-inch OD casing.
3. 2⅞-inch OD latch type landing collar or baffle assembly.
4. 2⅞-inch OD casing to point above pay zones.
5. 2⅞-inch OD pup joint with radioactive collar, each end. (Different length pup joints used in each string.)
6. 2⅞-inch OD casing to surface.

If more than two strings are run, these are bull plugged on bottom and equipped with radioactive collars as described previously.

Centralizers or turbulizers are used on all strings and are spaced one per joint from the shoe through the productive interval. Also, centralizers are used one per joint between closely spaced reservoirs and through water bearing sands. If cement is to be displaced into surface pipe, centralizers are used one per joint on two strings only to the surface pipe. This practice keeps strings separated sufficiently and permits effective displacement of cement back to the surface pipe. Scratchers are spaced through potential producing intervals.

Cementing is always performed through at least two strings regardless of the type multiple completion.

Installation No. 6—Design for positive isolation of pays, Figure 19. If considerable difficulty is experienced in obtaining shut-off adjacent to producing intervals, one bull plugged string of the previously described installation (No. 5) may be equipped as follows:

1. 2⅞-inch OD bull plug.
2. 2⅞-inch OD casing to first pay zone.
3. Sliding sleeve circulating valves spaced immediately below each potential producing intervals.
4. 2⅞-inch OD casing to surface.

Other strings are equipped as shown in Figure 17.

The circulating valves permit selective squeeze cementing of each producing interval after the primary cementing job. In operation, the primary cement job would be displaced through the cementing strings. Each sleeve then would be opened from the bottom up and an attempt would be made to obtain a bradenhead squeeze pressure on each interval. If a squeeze could not be obtained, a small quantity of cement would be left in the casing string above each tool.

In this case, the string equipped with the sleeves or

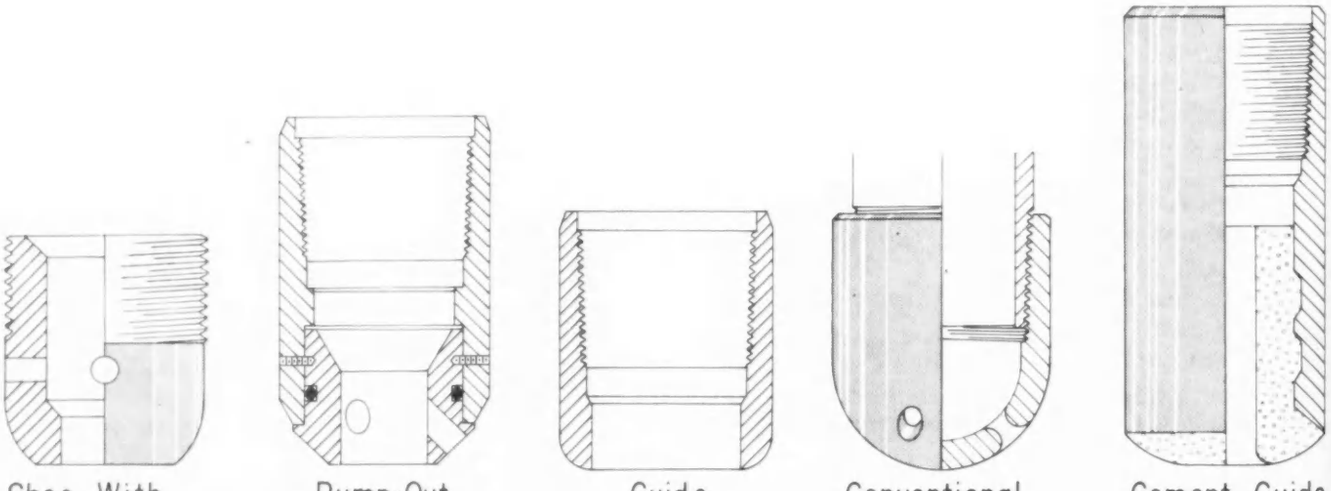


FIGURE 20—Guide shoes for small diameter well completions.

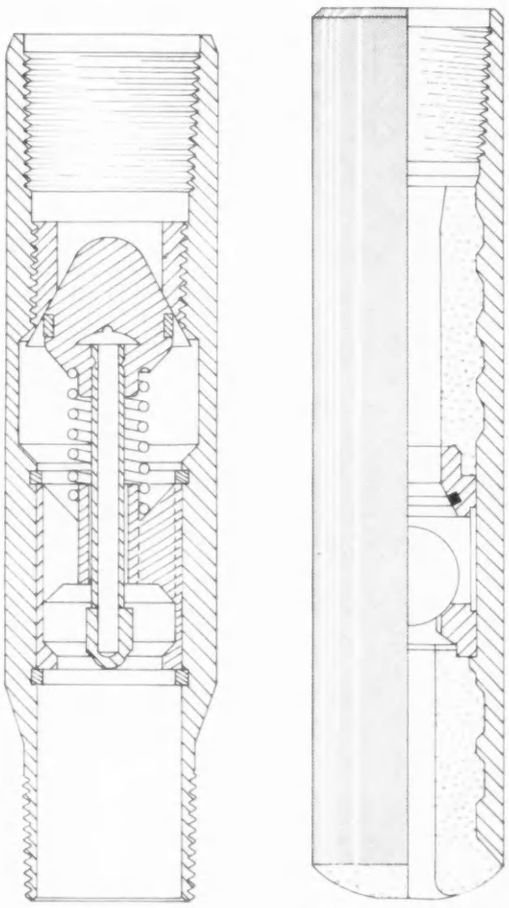


FIGURE 21—Float equipment for small diameter well completions.

would be completed in the upper-most pay to eliminate drill out of cement in the sleeve areas below.

PRIMARY CEMENTING EQUIPMENT

Almost all equipment previously used in cementing conventional wells now is available for small diameter completions. Essentially, conventional equipment has been scaled down (and in some cases modified to provide greater flow areas) to meet the needs of operators using small casing. Also, several special items have been developed for use with the technique.

The following discussion will briefly cover equipment now most often used in cementing single and multiple small diameter wells.

Guide shoes. Guiding action for small casing strings is provided by several types of shoes. Those in general use are shown in Figure 20, including one with a pump-out nose.

Once casing is on bottom, a tripping ball is used to shear the plug from the shoe equipped with the pump-out nose, resulting in a full open tool. This feature eliminates restriction in the shoe during cementing operations.

Float shoes, collars. Available float equipment consists essentially of both scaled down conventional and modified

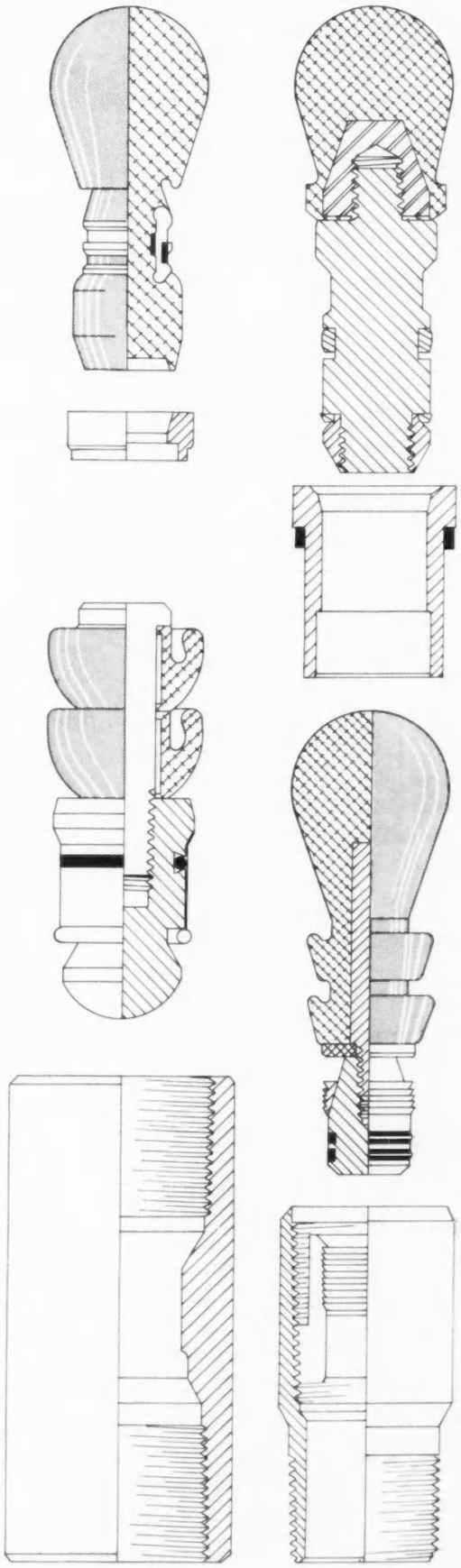


FIGURE 22—Latch type cementing equipment for small diameter well completions.

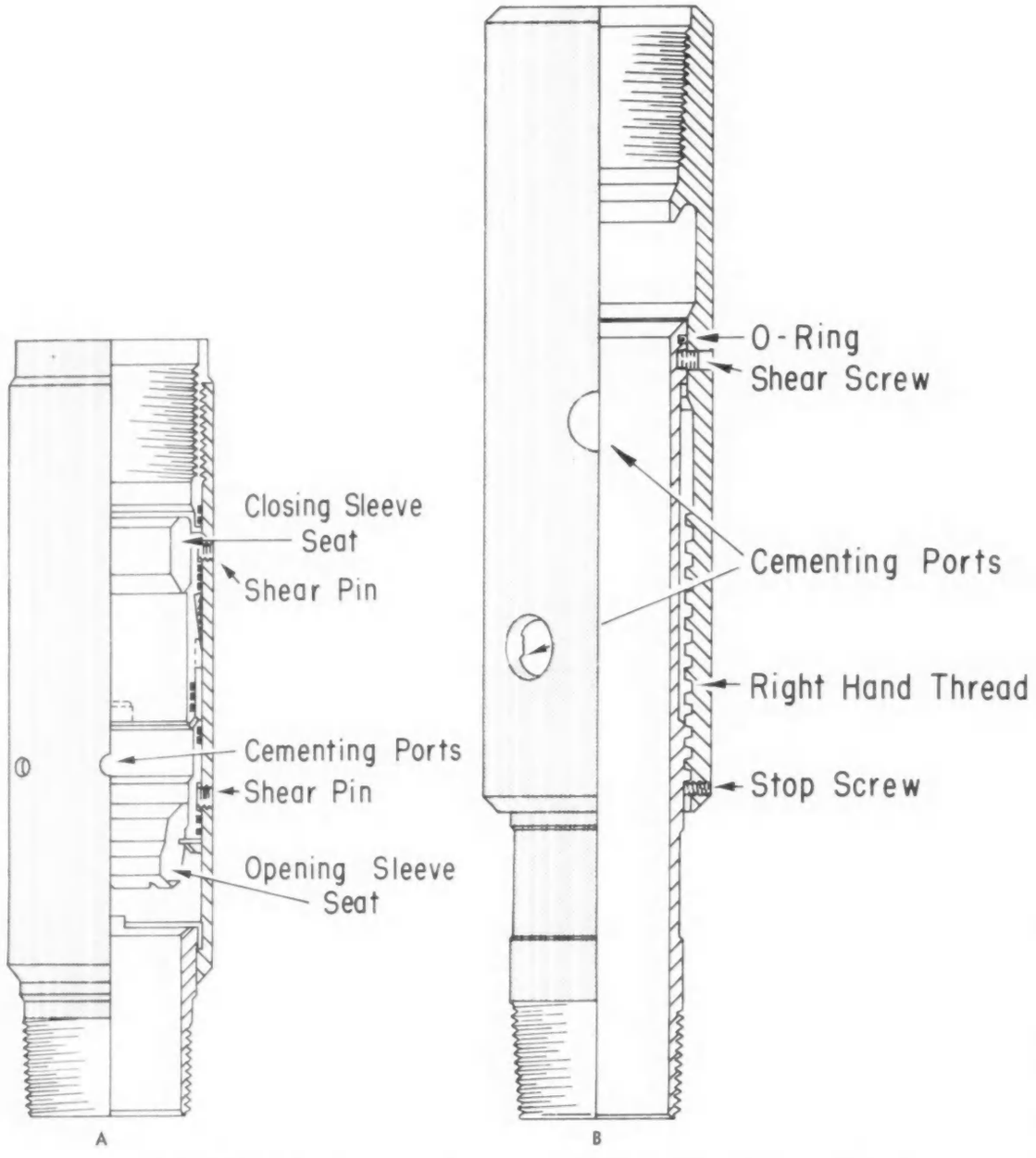


FIGURE 23—Stage cementing equipment for small diameter well completions.

tools (Figure 21). In some cases, fluid passages in the shoes and collars have been enlarged to reduce flow restriction and cutting action.

Latch-in equipment. Cementing practices utilizing latch type equipment have become quite popular in small diameter well operations. Its use precludes installation of float equipment since latch plugs provide resistance against back flow of cement.

Both latch-in baffle and landing collar type equipment has been used successfully. The drillable baffle arrangement is simply inserted between casing joints and serves as both a seat and anchor for the latch type plug. Latch-in collars are made-up in the casing string and used in a similar manner.

Recent developments in latch-in plug design have almost eliminated cement by-passing of plugs during displacement. With some early models, considerable cement was left in the pipe above the plug. Thus, a cleanout trip with a macaroni tubing string was required prior to completion. Ball type plugs with an enlarged OD have been successful in preventing this occurrence. The ball type configuration results in the plug deforming into a cylindrical shape during displacement, and provides efficient wiping action.

Several types of latch plugs are shown in Figure 22. Once the plugs reach the landing baffle or collar, a snap ring locks into place or a slip type hold down is engaged, thus preventing the plug from being forced up the hole due to the head imposed by the annular column of cement.

Stage cementing equipment. This type equipment also has been modified from conventional stage cementers. Tools may be used to place more than one stage of cement on the outside of the casing string.

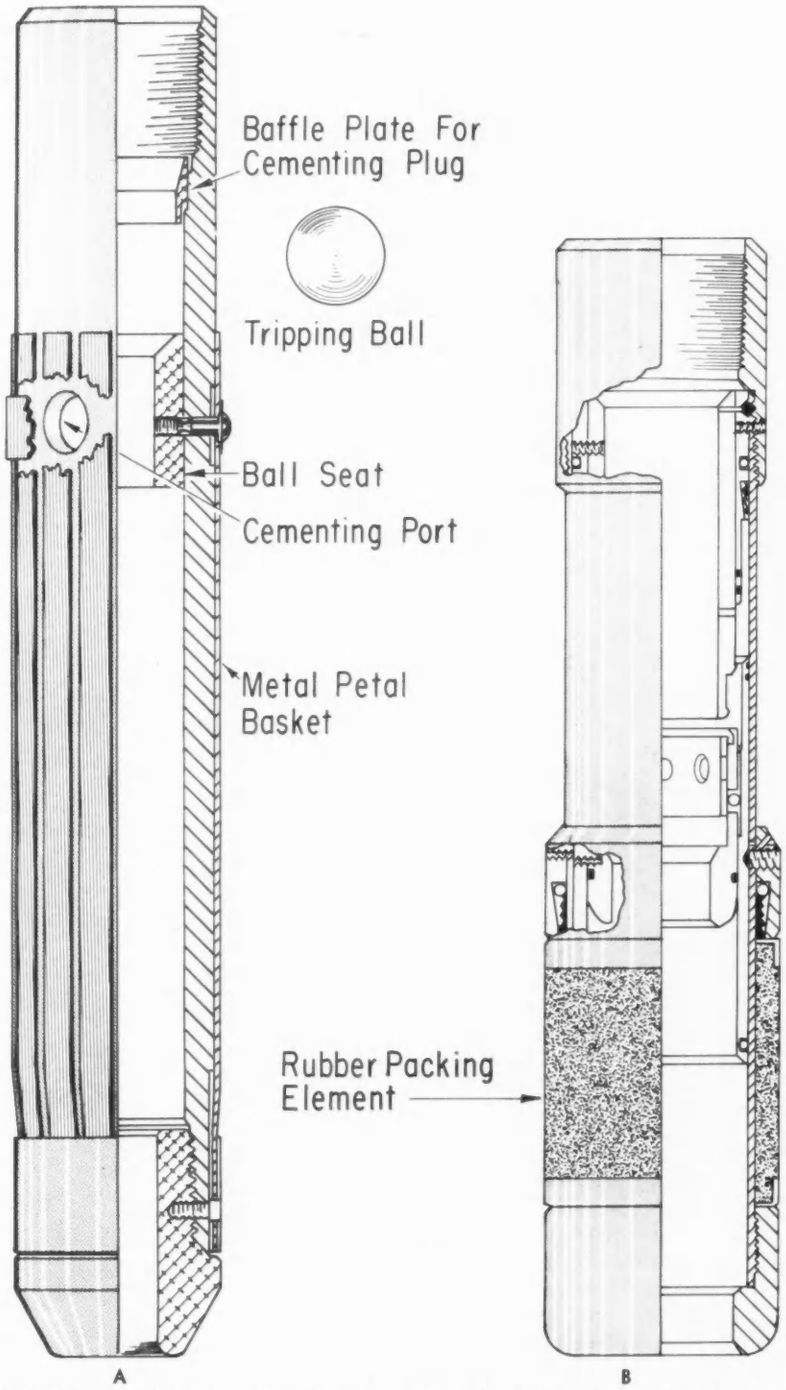


FIGURE 24—Basket and packer type cementing shoes for small diameter well completions.

Stage cementing equipment now available consists of the type actuated by bomb type plugs (Figure 23A) for opening and closing and a type which is actuated by right hand pipe rotation. (Figure 23B.) The former type requires drill-out prior to completion, while the latter does not.

Basket and packer type cementing shoes. This equipment has been used to advantage in open hole completion operations to prevent cement contamination of the pay, or to prevent cement column sloughing downward when pipe is set off bottom for any reason.

Basket type shoes (Figure 24A) operate as conventional float shoes while running. Side cementing ports are opened and the cement basket is released by a tripping ball which is pumped down the casing string. Slurry is displaced out the ports above the basket which serves as a "bottom" for the annular cement column. A back pressure valve prevents back-flow of cement into the string. The shoe then is drilled out for completion.

Packer type shoes (Figure 24B) operate in a similar manner. An opening bomb is used to open the side cementing ports and expand the packer element. Once slurry has been displaced out the ports (above the packoff), the follower or closing plug is seated in the tool. Continued application of pump pressure closes the cementing ports and discharges opening and closing plugs and the inner seats out the bottom of the tool into the open hole below. Thus, a drill-out trip is made unnecessary.

Other equipment. Many types of steel and rubber centralizers, turbulizers, tubing spacers and scratchers are available for small diameter well completions. Both reciprocating and rotating type scratcher elements have been developed, and are frequently used due to the difficulty in obtaining good primary cement jobs.

Cement baskets also are often used with small diameter well completions. These are spaced on the casing string if there is danger of downward movement by the annular cement column or lost circulation is a possibility.

For more detailed information or equipment of this type, the reader is referred to the various manufacturers.

ACKNOWLEDGMENT

Much of the material contained in this portion of Engineering Practices Report No. 4 was obtained through the cooperation of operators, drilling contractors, manufacturers and service companies. A complete Reference List and Acknowledgment for the entire Report will be included with the last installment of the series.

Part 3 of Engineering Practices Report No. 4, "Casing Running and Cementing Techniques" Will Appear in the October Issue of WORLD OIL

Technique Being Used Offshore

As an example of the increasing application of the small diameter well technique, it was reported in August that at least one offshore operator was working on a sub-sea completion in the Gulf of Mexico using small diameter casing.

Rarely does a publisher of exploration articles covering either new methods or prospective areas have the opportunity to make a thorough check of drilling results of previously-published wildcat and development prospects. Oil and gas exploration is by nature an intangible business. Yet, in previous articles published by WORLD OIL and by its predecessor, *The Oil Weekly* dating as far back as 1936, Dr. W. P. Jenny, distinguished consulting geologist and geophysicist has mapped a number of prospects based on micromagnetics. Some of them were undrilled or only partially drilled at the time of previous publication.

Dr. Jenny now has prepared a series of articles showing development through the latter part of 1960 on these and other magnetic and micromagnetic prospects, together with an up-to-date discussion of new techniques of micromagnetic interpretation. This is the first of a series of five articles.

Two-motored aircraft used for magnetic survey mounts two flux-gate type magnetometers (arrows), the upper in a "stinger" tail installation, the other in a trailing "bird." The two instruments are 200 feet apart. In addition to advantages mentioned in the article text, this installation permits recognition and elimination of random noise since results from each magnetometer serve to check those from the other. Useful resolution to 0.2 gamma is achieved by this technique.

PART 1

High aeromagnetic accuracy provides detailed coverage

By W. P. Jenny, Consulting Geologist and Geophysicist, Houston.

INTERPRETATION of magnetic data is being improved, paralleling the rapid strides being made in instrumentation and speed of magnetic survey coverage. The older, slower ground methods are being replaced by much faster airborne adaptations. Greater accuracy in measurements allows micromagnetic interpretation to provide a more precise means of magnetic exploration for oil and gas. Techniques are being developed to compensate for diurnal variations. Since the magnetic method of oil exploration has now been in use for about 35 years, and deep drilling has been done on many prospects first identified by magnetic or micromagnetic interpretation, a good backlog of experience has accumulated on which to base future exploration programs using this low-cost method.

Coverage which once required months on the ground now can be achieved in days in the air. Inaccessible terrain, of course, does not interfere with aerial surveys.

Through proper processing of aerial magnetic data, the regional orogenic trend and cross-trend patterns of the basement complex are revealed. These regional patterns are related much more closely to local structure, stratigraphy, flow of salt and migration of oil in the overlying sediments than is usually presumed. Regional structural and stratigraphic information gained from an aerial magnetic survey is therefore most valuable.

Aerial micromagnetics were developed from experience gained in development of ground micromagnetics. The author has previously demonstrated than accuracy of plus or minus ½ gamma per station can be achieved with the ground magnetometer and is needed for micromagnetic interpretations within the sedimentary section. In the air, because of the greater distance from shallow magnetic sedimentary beds, greater accuracy is necessary in spite of the considerable advantage of continuous records. The micromagnetic approach to sedimentary structural interpretation has been explained in a previous Article.[1]

During the past 15 years, the aerial magnetometer has been improved so that it furnishes not only magnetic data useful in basement interpretation but now also micromagnetic data for structural interpretations within the sedimentary column. With present instruments and techniques, continuous aerial micromagnetic profiles which repeat with an accuracy of better than plus or minus ½ gamma may be surveyed over 50 or 100 miles.

The introduction of dual level surveying[2] in which one instrument is flown on a cable 200 feet below a second instrument in the boom of the plane, with data from both recorded on the same tape, has been vital in achieving this accuracy.

The main advantage of dual level surveys is the possibility of selecting the more effective level. A deep-seated salt dome, for example, will produce the same weak negative anomaly at both levels. A shallow magnetic bed, uplifted over the dome, may produce a weak positive anomaly at the lower level sufficient to eliminate the negative domal effect, which may be only slightly dampened at the upper level.

In Figure 1 are shown tape records of a dual level survey over a salt dome prospect in the Gulf of Mexico. The upper tape shows the record surveyed on the northwest flight, the lower tape the record surveyed on the southeast flight along essentially identical paths some 300 feet (lower instrument) and 500 feet (upper instrument) above water. Reference datum for each record is arbitrary.

An aerial survey now may be conducted with such accuracy that small anomalies down to less than plus or minus ½ gamma are registered, which may then be processed into micromagnetic shape patterns and superimposed upon regional magnetic information. These micromagnetic anomalies are indicative of local struc-

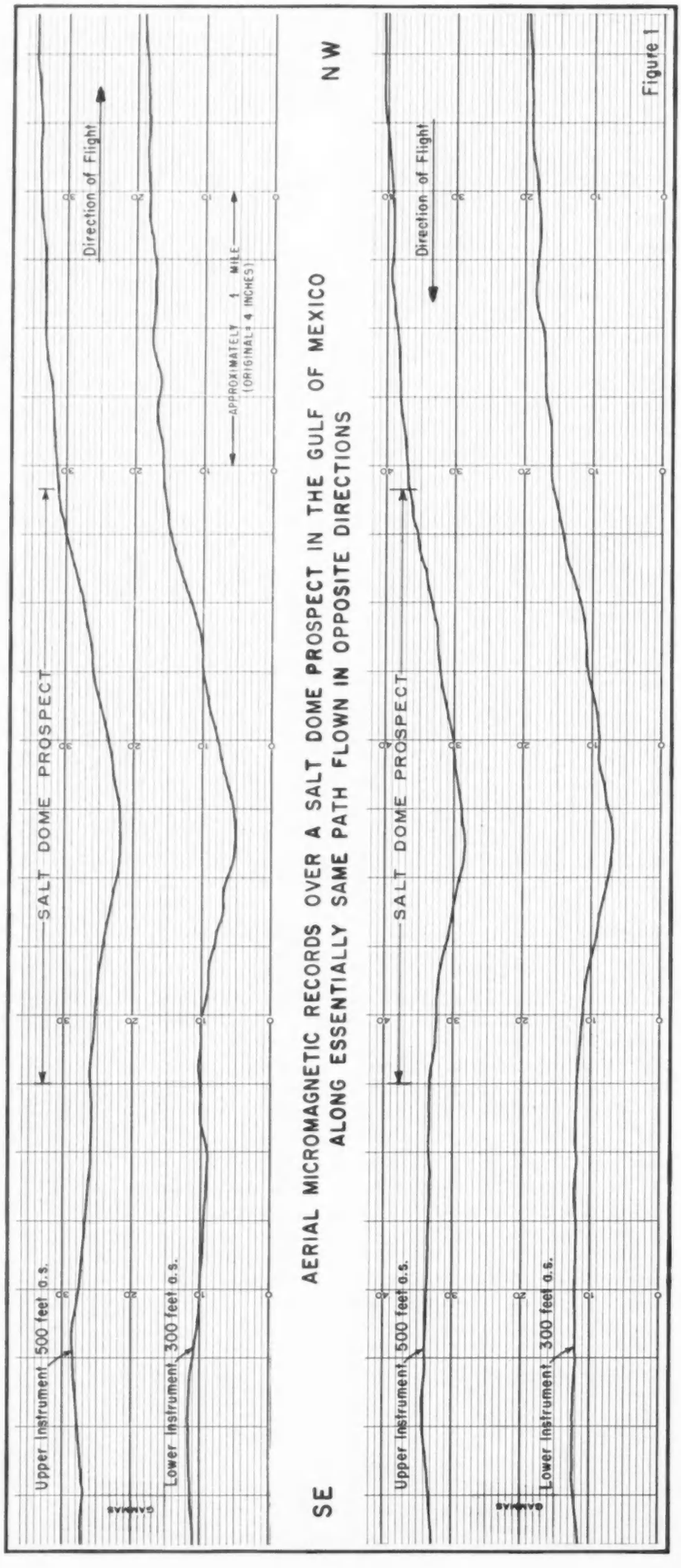

AERIAL MICROMAGNETIC RECORDS OVER A SALT DOME PROSPECT IN THE GULF OF MEXICO
ALONG ESSENTIALLY SAME PATH FLOWN IN OPPOSITE DIRECTIONS
SE
NW
SALT DOME PROSPECT
Direction of Flight
APPROXIMATELY 1 MILE
(ORIGINAL = 4 INCHES)
Upper Instrument 500 feet o.s.
Lower Instrument 300 feet o.s.
SALT DOME PROSPECT
Direction of Flight
Upper Instrument 500 feet o.s.
Lower Instrument 300 feet o.s.
Figure 1

FIGURE 1—Tape records of a dual level survey over a salt dome prospect in the Gulf of Mexico. Aerial surveys now provide accuracies to better than plus or minus ½ gamma, allowing micromagnetic interpretation. Deep-seated salt dome will produce same weak negative anomaly at both levels, but minute variations in two curves may be significant to interpretation of less obvious structural and stratigraphic features.

ture and possibly also of stratigraphy within the very shallow subsurface.

For the successful application of micromagnetics within the shallow sedimentaries three conditions must be met:

- First, that the sediments contain sufficient magnetic material and that different beds be of different magnetic susceptibility
- Second, that deep structures penetrate shallow beds, through differential settling, compaction, draping, etc., if not through structural rejuvenation
- Third, that even though the growth of a structure should stop at great depth, it may yet affect the sedimentation above by slightly changing the magnetic and gravimetric potentials during deposition.[3]

In the dust-storm sediments near Lubbock, Texas[4] a heavy mineral content of 0.5 percent was measured. It appears conservative to assume that half of the heavy minerals is magnetite. At that rate a 300-foot-deep cone below the ground magnetometer would contain thousands of tons of magnetite acting upon the instrument.

Results obtained by the marine sonar probe[5] and the continuous seismic profiler[6] indicate structures at shallow depths of from 50 to 300 feet, undoubtedly expressions of deep-seated structures.

(In the second part of this series to follow, the author shows studies of regional magnetic trends in different areas, including central Louisiana and the entire country of Venezuela).

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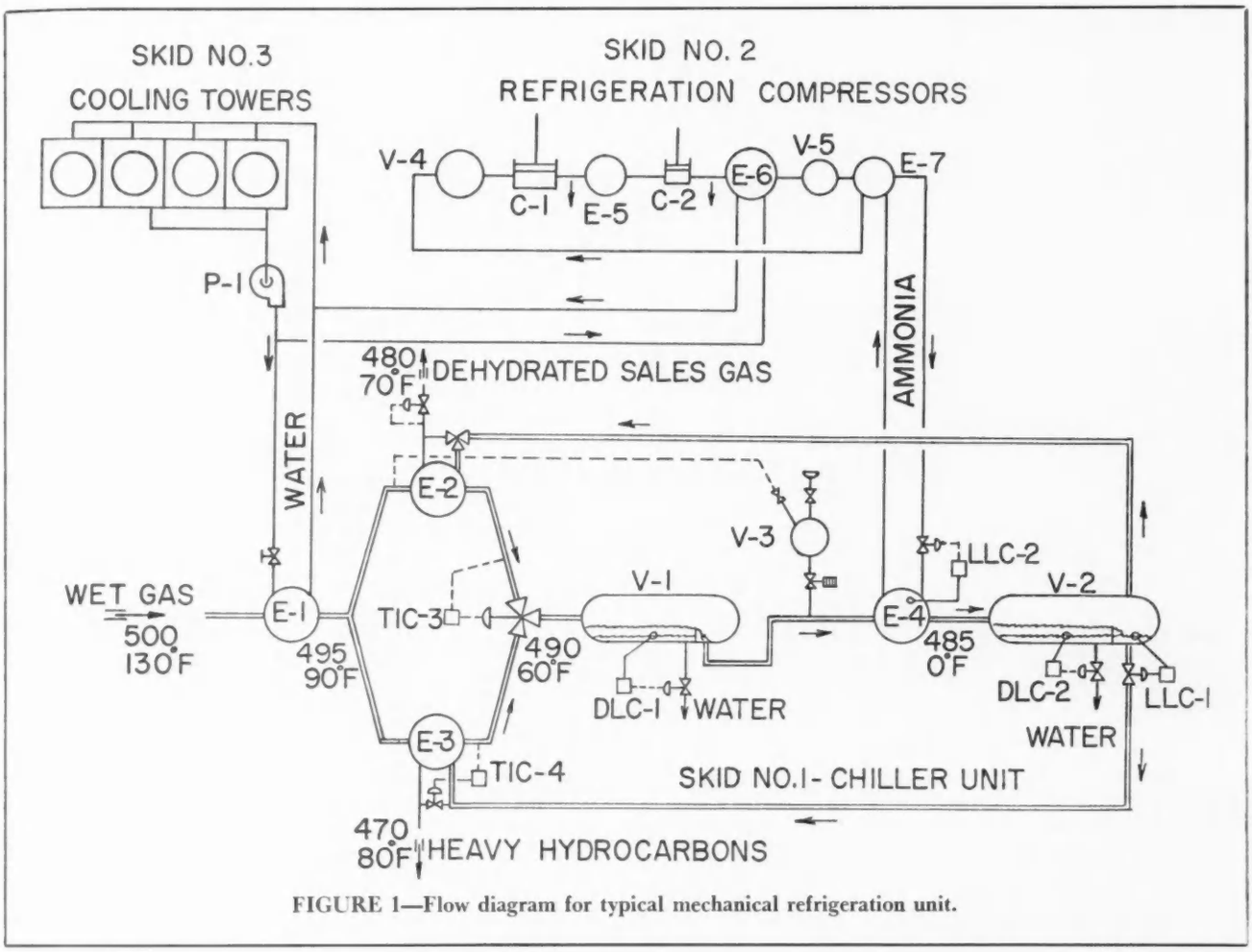


FIGURE 1—Flow diagram for typical mechanical refrigeration unit.

New hydrocarbon extraction unit designed for small, rich gas streams

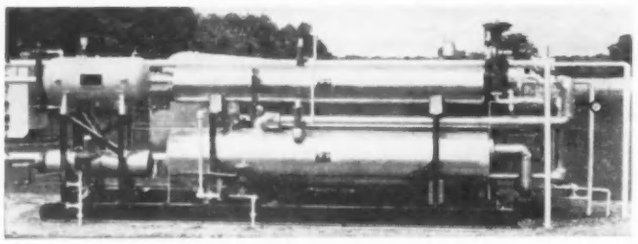
Skid-mounted, packaged low-temperature separation equipment uses compression refrigeration cycle, can be applied to leases producing as little as 500 Mcfd

By J. L. Horton, Manager, Product Development
The J. B. Beaird Co., Inc., Shreveport

RECENT SIZE and cost reductions in compressor equipment has resulted in development of small, packaged, low temperature separation units utilizing the compression refrigeration cycle. Presently, these units can economically dehydrate and extract liquid hydrocarbons from field gas streams as small as 500 Mcfd. It is anticipated that future developments will result in low cost units capable of handling streams as small as 100 Mcfd.

The mechanical refrigeration-compression unit is best suited for small, relatively low pressure, rich gas streams. However, its application is not limited to such cases. Mechanical-compression units also can be used:

- To supplement low temperature separation systems using pressure drop as a source of refrigeration. The mechanical units would provide cooling when declining well head pressures made it impossible to obtain adequate low temperatures by expansion alone.
- To economically strip and dehydrate gas from small reservoirs which might not support a comparable facility of another type.
- In conjunction with short cycle hydrocarbon recovery units. The refrigeration unit would be used initially to



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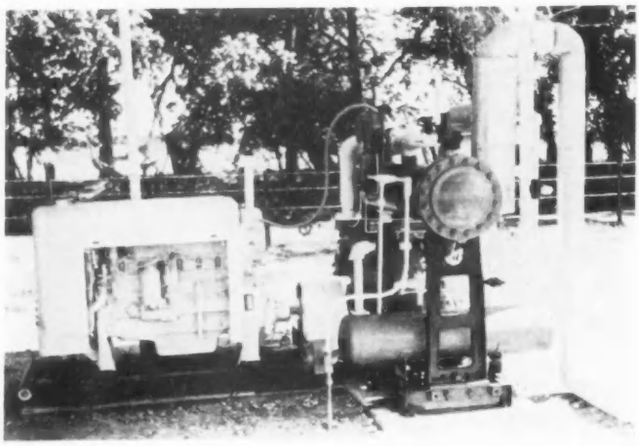

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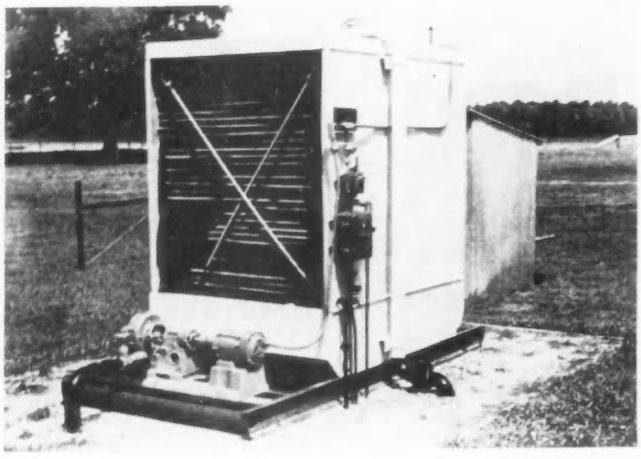

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FIGURE 2—Complete mechanical refrigeration unit consists of these three skid mounted components: (A) Chiller equipment; (B) refrigeration compression equipment; and (C) packaged cooling tower equipment and circulating pumps.

handle produced gas. The short cycle unit then would be used in handling the lean effluent gas from the refrigeration unit.

Compression refrigeration is not a new innovation in handling of natural gas since it has been used effectively in large installations for a number of years. However, it has been only recently that a standardized, skid mounted packaged unit has become available for unattended field production use.

Equipment. Figure 1 is a flow diagram of a packaged compression refrigeration unit. The inlet stream enters water cooled heat exchanger E-1. It then is split through hydrocarbon gas HEX E-2 and hydrocarbon liquid HEX E-3, where the respective leaving streams are utilized to absorb heat from the entering stream. The stream next passes through water knockout V-1, which is maintained at a temperature slightly above the hydrate point.

Immediately downstream from the knockout, methanol is injected as an anti-freeze. Due to the prior removal of water, condensed at temperatures above the hydrate point, an economical quantity of methanol is required. The mixture then passes to the main chiller, ammonia evaporator E-4, where it is cooled to the desired operating temperature (0° or lower). The chiller may be of the fin or kettle type, depending on cooling load and particular application.

Gas and liquids pass from the main chiller to three-phase separator V-2 where condensed water, hydrocarbon liquids and gas are separated. Cold liquids and vapors then are switched back to the heat exchangers handling the main stream.

Ammonia is used as the refrigerant and water is the condensing medium. Two stages of compression are required. Intercooling is necessary between compression stages and a subcooler and superheater are employed.

The unit consists of three skids: The chiller skid (Figure 2A) contains controls, piping, exchangers and vessels to handle the gas stream; the second skid (Figure 2B) carries refrigeration compression equipment; and the third skid (Figure 2C) consists of packaged cooling tower equipment and circulating pumps.

Figure 2 shows components of a unit capable of handling 500 Mcfd. Freon 12 is used as the refrigerant, and the unit operates with a water cooled condenser developing approximately 12 tons of refrigeration. The gas stream is cooled to 0° F, and the resulting condensate is separated in the lower vessel shown in Figure 2A.

Limitations. Mechanical refrigeration is used principally to handle rich streams of gas. It is not economical on lean streams due to the absence of heavier components which facilitate condensation. A careful analysis must be made of each individual stream to determine if mechanical refrigeration can be an economical approach to condensation.

Obviously, unit operating pressure and market for the liquid product are all important. It is not expected that refrigeration units will ever be able to compete with the dry desiccant equipment normally used for lean streams.

A good rule of thumb for determining whether mechanical refrigeration is advisable is as follows: If a gas stream, flashed at design temperature and pressure, yields at least 1½ gallons of product per Mcf on a flow of 1½ million feet per day or at least ¾ gallon of product per Mcf on a flow of 7.5 million feet per day, then refrigeration bears investigation.

Design. An optimum unit operating pressure and temperature must be determined prior to selecting refrigeration equipment for a given stream of natural gas. It is generally known that a reduction in temperature and an increase in pressure will result in a greater volume of condensate from a given stream. However, the lower the temperature and the higher the pressure, the greater the power required.

Figure 3 illustrates the problem involved in selecting this temperature and pressure. A typical wet gas stream

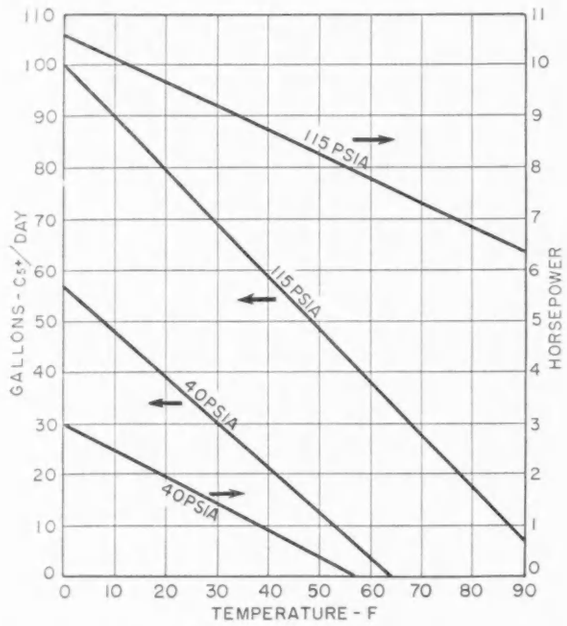

FIGURE 3—Power requirements versus gas temperature at two pressure levels.

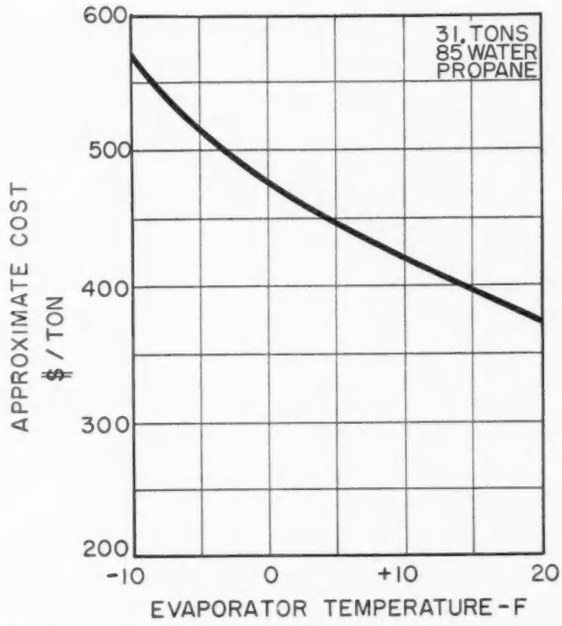

FIGURE 4—Approximate initial cost of refrigeration equipment at various evaporator temperatures.

was selected and computations were made of recovery and horsepower at various temperatures and two pressures (40 psia and 115 psia). The figure shows that if gas is handled at 40 psia, the gallons of C_5 + produced per day will vary from zero at 63° to 57 gallons at 0° F. In a like manner, if the unit handles the same stream at 115 psia, about 75 gallons per day of C_5 + will be recovered at 63° and 100 gallons per day at 0° F. Obviously, the maximum condensate would be produced at the higher pressure and lower temperature as stated above.

The lower curve of Figure 3 is based on the assumption that gas is available at 40 psia, and it shows horsepower necessary to cool it to operating temperatures. Note that three horsepower are required to obtain a temperature of 0° F.

The top curve shows the sum of gas compression horsepower and refrigeration horsepower required to produce 115 psia and the indicated chiller temperatures. Notice that at 63° approximately 7½ horsepower is required, while at 0° F and 115 psia, 10.8 horsepower is required. With the two pressures shown on the same plot, it is possible to compare horsepower requirements per day for a given liquid product.

For example, a chiller temperature of 8° F and about 2.6 horsepower are required to recover 50 gpd of C_5 +. At the higher pressure, chiller temperature can be raised to about 48°, but horsepower increases to about 8.2. In this example, at least three times as much power is required for the same recovery at higher chiller temperatures and higher pressures.

The preceding discussion emphasizes the need for investigating practical operating temperature and pressure ranges. If gas is to be sold, operating pressure must equal or exceed sales line pressure, or correspond to well head pressure or interstage pressure if gas compression is used.

The problem is further complicated since equipment cost increases as evaporator temperature of the regrigeration system decreases. Figure 4 is a plot of relative cost per ton versus evaporator temperature. A temperature drop from +20° to —10° F almost doubles the cost per ton of refrigeration. Thus, the designer must select the operating temperature which will give the best recovery. At the same time, the temperature must be as high as possible so that equipment costs are held to a minimum.

Figure 5 shows relative cost of refrigeration equipment versus unit size and compares propane and ammonia re-

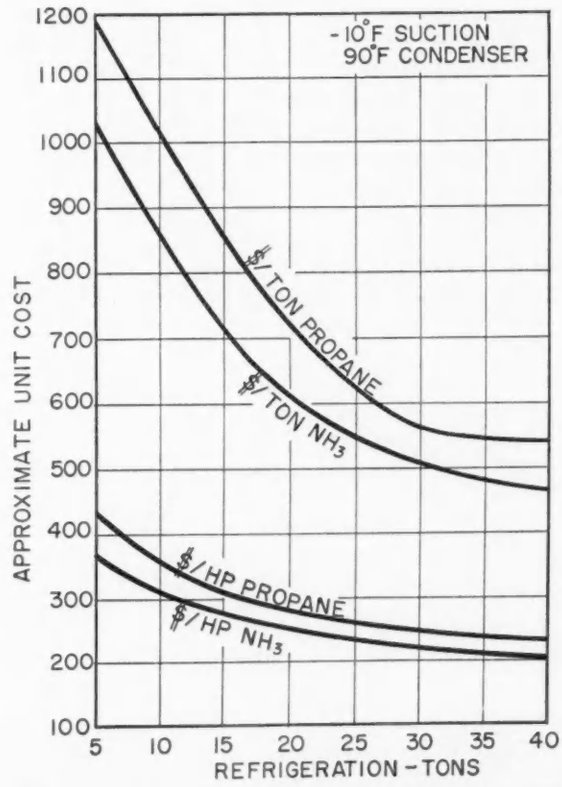

FIGURE 5—Approximate unit cost of refrigeration equipment at various loads.

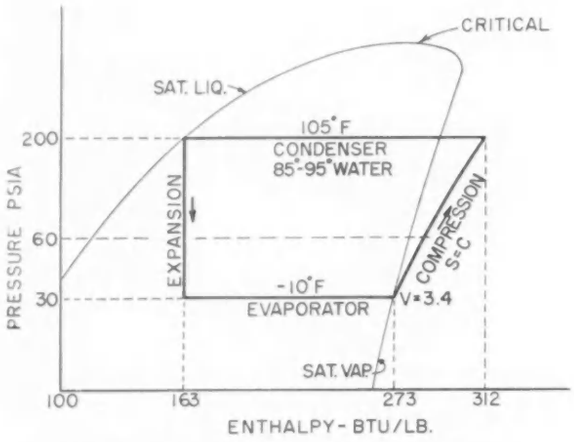

FIGURE 6—Propane refrigeration process.

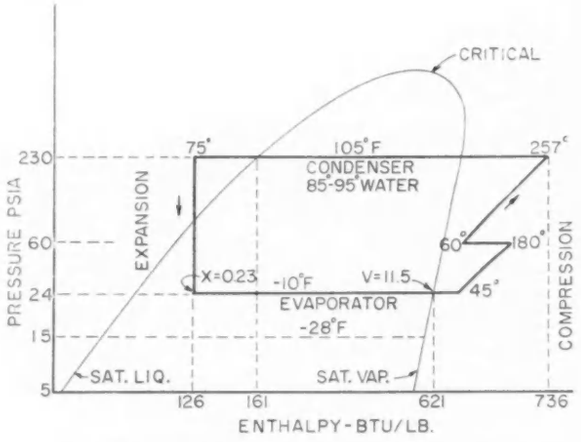

FIGURE 7—Typical ammonia process.

frigerants. As in all types of equipment, unit cost decreases as equipment size increases. In fact, cost per ton in small equipment more than doubles from the 50 to 5 horsepower range.

Cost per horsepower in the same range does not vary as much. Therefore, the operation should be designed for least amount of refrigeration and compression.

The refrigerant used should be that most applicable from the standpoint of safety, utility, cost and horsepower per ton. Figure 5 shows that ammonia generally requires less horsepower per ton than does propane. However, propane is frequently one of the products produced, and its use is widespread.

Freon also is available in a number of forms with varying properties. It is considered safer than ammonia or propane, but is more expensive from the standpoint of initial cost. This additional cost is sometimes offset by a reduction in equipment cost because in some instances Freon requires only single stage compression whereas ammonia may require two stages.

A typical refrigeration cycle using propane is shown in Figure 6. Change of enthalpy in the evaporator determines how many pounds of refrigerant must be circulated for a specific cooling job. Change of enthalpy in the compression process determines horsepower required. Heat added in the evaporator and compressor is rejected in the condenser, as indicated by the top line of the cycle. No change of enthalpy takes place in the expansion valve, as evidenced by the left-hand vertical line of the cycle.

Figure 7 is a typical ammonia refrigeration cycle using water as the condensing fluid. This figure shows a heat exchanger added to the cycle which allows sub-cooling of the liquid ahead of the expansion valve and superheating of the refrigerant vapor between the evaporator and the compressor.

For a given refrigerant, it is apparent that the least horsepower for the cycle is required when using a minimum condenser and a maximum evaporator temperature.

Figure 8 shows the effect of condenser temperature. Notice the greater change in enthalpy when air is used as the condensing medium as compared to 85° cooling water.

The preceding discussion emphasizes the fact that least cost results when using: (1) lowest possible condensing temperature; (2) highest evaporator temperature; (3) a refrigerant which requires least horsepower per ton for a given cycle; and (4) least possible total refrigeration load.

In addition, use of standard refrigeration machinery generally offers lowest cost and most satisfactory service. Also, cold streams leaving the main chiller for further processing where heat is added should be switched back to absorb the heat of the entering stream. The removal of heat by this means results in lowering the total refrigeration load in the main chiller. **—The End**

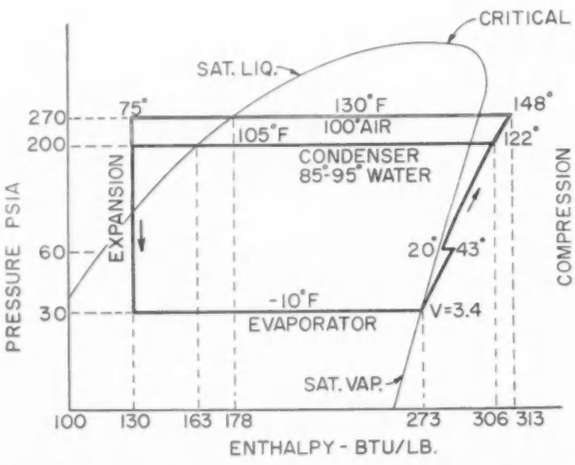

FIGURE 8—Typical propane process, water versus air cooling.

About the Author

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High-pressure CO_2 treatments boost production

Discharge of gas opposite open hole or perforated producing intervals removes scale deposits, lowers well stimulation treating pressures

By G. M. Henry, Vice President **and R S. Frost,** Director of Research
Well Production Services, Inc., Chicago

HIGH-PRESSURE CARBON DIOXIDE is being successfully used in both producing and injection wells to unblock plugged perforations, lower formation breakdown pressures prior to fracture or acid jobs and clean out open hole intervals. Although CO_2 discharge pressures average 17,500 psi, there have been no instances of casing or tubing damage reported to date.

Carbon dioxide was selected for the operation because of its physical and chemical properties. Expansion at working pressures is high enough to provide continued action in the formation after initial pressure drop; it is inert; and it will not support combustion. In addition, its function in reducing surface tension and viscosity of crude oil is well known.

The tool used to discharge the high pressure gas in the well is shown in Figure 1. A re-usable alloy steel tube contains a 1,000 psi carbon dioxide charge and a specially compounded chemical heater. Activation of the heater by electric current produces sufficient heat to raise the pressure within the tube to a maximum 25,000 psi. The shear disc (Figure 1) is designed to rupture at a pressure between the maximum 25,000 psi and a minimum 15,000 psi, permitting CO_2 to move through the lateral discharge ports into the well bore at a velocity of about 2,000 fps. Gas is evacuated from the chamber in about 11.5 milliseconds (Figure 2).

At an average discharge pressure of 17,500 psi, 140,000 foot pounds energy is available to accomplish desired work in the well. Release of energy in this manner differs from high explosive in that both shock wave and peak pressure are less severe. Formation damage thus is minimized and a more deliberate disposition of discharge energy is obtained.

Under average operating condi-

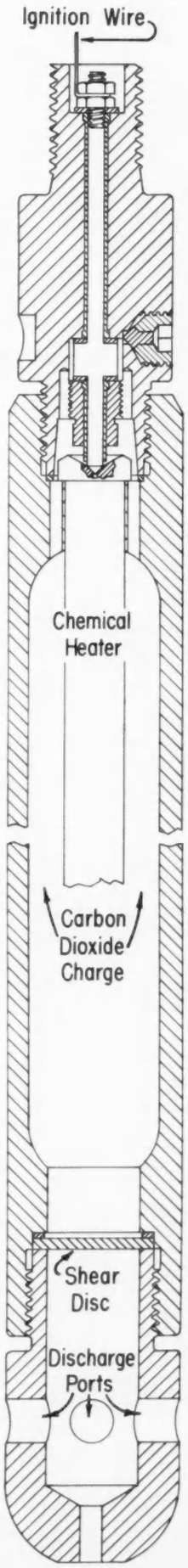

FIGURE 1—Carbon dioxide treating tool is run on electric line, spotted opposite producing interval. Chemical heater causes instantaneous rise in pressure in chamber and ruptures shear disc. CO_2 then is discharged from ports into formation under 15,000-25,000 psi pressure.

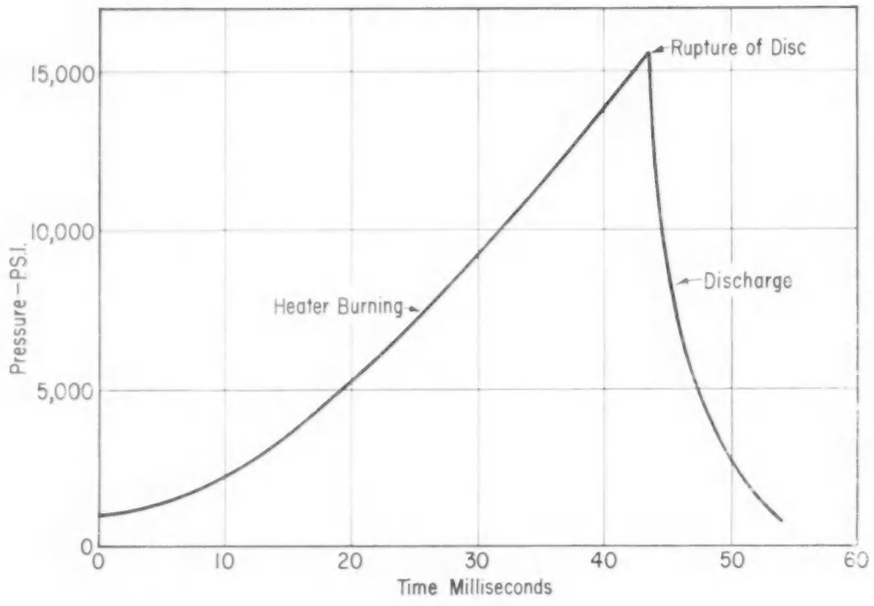

FIGURE 2—Here is a typical pressure-time curve of a CO_2 discharge. Note tool is evacuated in about 11.5 milliseconds.

tions, the tool is run on a conventional electric wire line and is positioned opposite the zone to be treated. The discharge is made at a pressure that is predetermined in accordance with local well conditions. A liquid head (oil, water or a mixture of both) in the well increases effectiveness of the discharge. Working under high liquid head does not affect mechanical operation of the tool and increased bottom hole pressure may be compensated for by raising discharge pressure.

In operation, discharge ports direct the expanding gas radially from the tool for direct impingment on the formation face or casing. In seven inch hole or casing, approximately three feet of interval is covered by each discharge.

When a liquid head is present, the gas travels outward from the discharge point and physically lifts the column of liquid. The high pressure release of gas is followed by a period of substantially reduced pressure immediately surrounding the discharge area. This condition is responsible for deposits (gypsum, paraffin, barium sulphate) loosened and broken by the high pressure discharge, being brought back into the well bore. These materials then may be removed by bailing as required. It is not uncommon to obtain a three to six foot fill-up in the well bore after treatment.

The extent to which the formation is affected by the high pressure shock wave and then by action of the expanding gas is a function of formation physical characteristics, type fluid in the well and type and thickness of the blocking material. A gypsum build-up, for example, can best be treated with smaller volumes of gas released at higher pressures. After removal of the gypsum deposit, the formation then can be exposed to the action of a larger volume of gas at lower pressures.

Tight formations will be affected to a lesser degree than will unconsolidated sands with high permeability and porosity. However, field results indicate that many tight formations will fracture at substantially lower pressure or will receive injected water at higher rates and lower pressures than before treatment.

Although pressures attained are relatively high and periods of gas discharge is relatively short, the treatment is not an explosion. The simple expansion of liquid to gas within a confined chamber and its quick and controlled release is the source of pressure and the resultant energy. The shock wave is rolling in character and will not cut tubing or casing even at the top of a column of fluid; no heat is generated by the discharge; and variations in pressure and volume are simple mechanical adjustments.

—The End

TABLE 1—Field Results of Carbon Dioxide Stimulation

Type Well	Problem	Treatment	Results
Oil	Gypsum-plugged perforations. Rod and tubing job required every 45 days	3 high-pressure discharges in 10′ section.	7 bopd increase, well has not required pulling in 8 month period.
Gas	Formation plugging, well dead.	3 high-pressure discharges in open hole.	Bailed frac sand, cement, shale. Production restored to 2 MMcfd.
Water Injection	Injection rate declined 50% because of formation plugging.	6 high-pressure discharges in open hole	Injection rate increased from 40 to 124 bwpd.
Gas Condensate	Good gas flow but only trace of distillate.	4 high-pressure discharges in open hole.	Distillate production increased to 197 bpd w/5 MMcfd gas.
Oil	Plugged perforations, production declined to 15 bopd.	2 high-pressure discharges in 5′ section.	Production increased to 80 bopd.

About the Authors

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Ralph S. Frost is director of research of Marmon-Herrington Company, Inc., Chicago. He attended Illinois Institute of Technology for both undergraduate and graduate work. He spent five years in the chemical industry before joining Marmon-Herrington in 1955. He has been active in the National Society of Professional Engineers and has been a director on the state board.

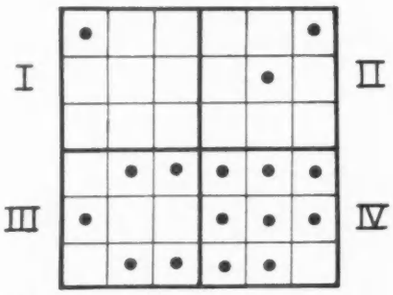

FIGURE 1—Macrostate composed of four microstates, with certain cells being occupied. This diagram denotes random dispersion of gas molecules and also shows similarity to an oil field map. Figure is intended to represent a bridge between fields of thermodynamics, mathematics, and oil exploration and development.

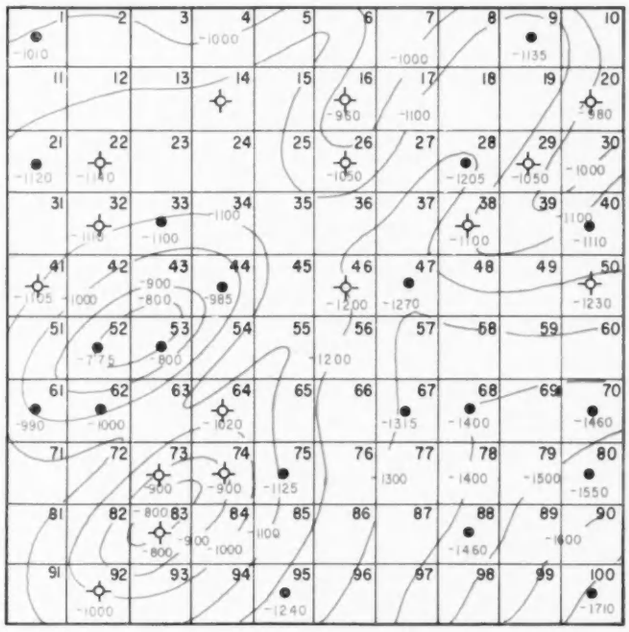

FIGURE 2—Map is marked off in 100 squares to represent any given spacing. Structural contours are on a persistent limestone marker. Producing closure in center, left indicates some structural control of production while dry closure at lower left and monoclinal feature in lower right indicate lack of structural control of production.

Mathematical probability is an oil-search tool

Independent producer's success based mainly on applied entropy and computer routines

By John P. Dowds, General Manager and Partner
Anabaco Operating Company
Oklahoma City

THE ANABACO OPERATING COMPANY, an independent oil and gas producer, has been using entropy-like expressions (mathematical probability) to analyze sedimentary rocks and their hydrocarbon content to increase the likelihood of finding production and to minimize uncertainties in prospective multiple pay zone areas. After more than three years of operations, the company has 5,200 acres of productive leases. Success ratio of the drilling program as of June 1961 stood at 82 percent. As development wells are drilled, this percentage should increase.

Entropy. Most geologists believe it is impossible to use a mathematical approach to subsurface problems because there are too many variables. However, a number of areas of mathematics dealing with combinatorial analysis, statistical variance, random theory, stochastic processes, etc., can be helpful. Entropy studies developed in this presentation are ideas that have been borrowed from information theory and statistical mechanics.

Information theory. This new science is rapidly finding application in many fields. The definition for the measure of information is given by the equation

$$S = -\int_{\infty}^{\infty} q(x) \log q(x)\, dx$$

which expresses information as the logarithm of the number of choices of possible events, S being the entropy. Because rocks and hydrocarbon saturations occur as discrete entities, the previous integral degenerates into

$$S = -K \sum_{e=1}^{\infty} q_i \log q_i$$

to examine the entropy of geological data and reservoirs as discrete sets of probabilities.

In geology a simple bivariant case between shale and sand particles involves only two lithologic possibilities. Where they might occur in equal volumes and thoroughly mixed, the rock

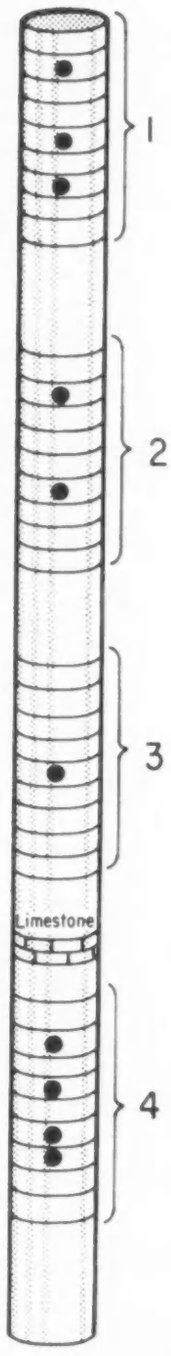

FIGURE 3—A hole with 4 lithotopes with 9 zones in each. Black dot indicates presence of hydrocarbons. Limestone marker lies between lithotopes 3 and 4.

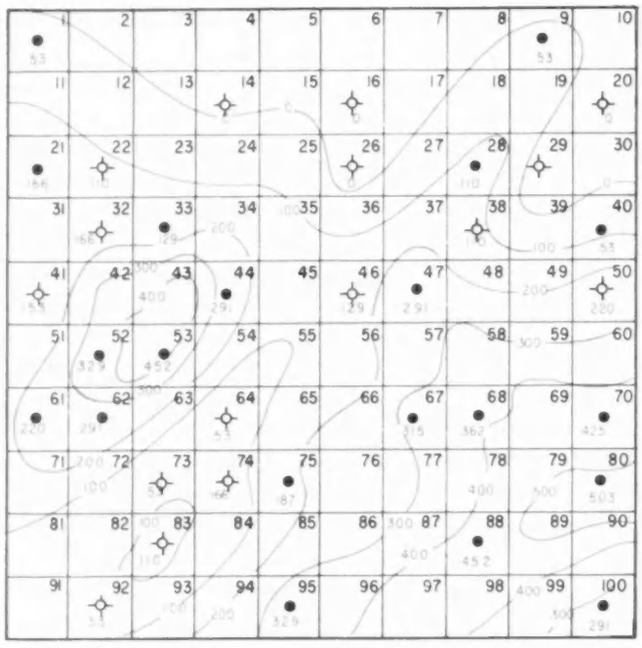

FIGURE 4—This entropy map summarizes $q_i \log q_i$ values of each interval of each well. As the hydrocarbon content increases from zero in each zone of each lithotope to a value indicating production, entropy decreases.

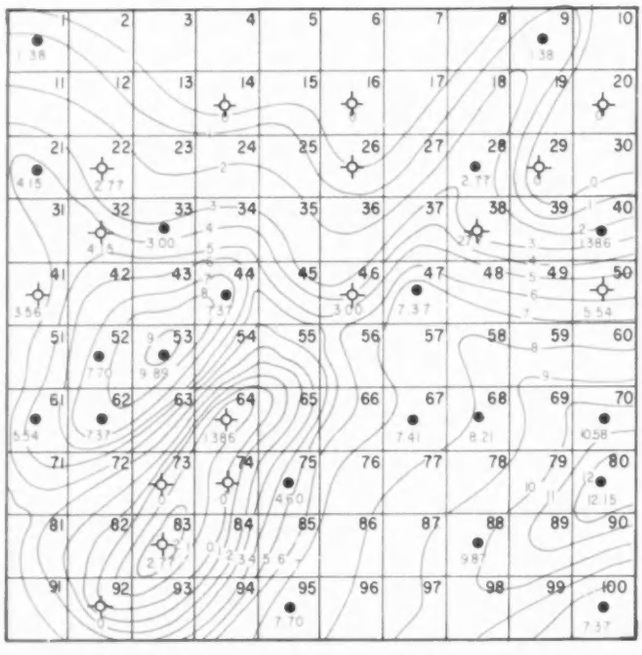

FIGURE 5—This entropy map is based on wells as macrostates; logarithms of the probabilities of various complexions due to the presence or absence of hydrocarbons in each microstate (lithotope) have been summed up. These computations were made using Naperian logarithms.

would be mathematically at maximum entropy or S = 1.000. As the sand/shale ratio increases, entropy decreases, and the rock "with certainty" becomes more of a sandstone with an increasing probability of developing effective reservoir porosity. If the rock is 95 percent sand and 5 percent shale instead of 50-50, the entropy value decreases to 0.21 from 1.00. This is also a measure of the certainty of finding a clean porous sandstone.

Various logging devices are available to gather sand-shale and limestone-shale data to make rock distribution studies possible. The entropy expression can be expanded to shale-sand-lime or anhydrite-gypsum-halite-dolomite systems of any complexity. Rock types are more realistically mapped by logarithmic contours than by conventional linear contour measurements.

The expression

$$S = -K \sum_{i=1}^{\infty} q_i \log q_i$$

is also useful in resolving reservoir engineering problems. If a reservoir has a 50 percent gas saturation and 50 percent water (critical saturation for this argument), the reservoir is at the state of maximum entropy (S = 1.000). It is highly uncertain which phase, or whether both phases, will produce.

If in an adjacent reservoir of the same geologic age gas saturation increased to 80 percent and water decreased to 20 percent, the S value of the second reservoir is 0.722 (from S = 0.8 log 0.8 + 0.2 log 0.2 = 0.722). This "gain" in information from the unpredictable first reservoir in which S = 1.000 is a measure of the increase of the probability of the reservoir to produce gas.

From probability contour maps prepared by analyzing the porosity and saturations of many geological zones, it is possible to construct multicolored maps to guide landmen in lease purchasing plays. If the probability of success of a hole is from 30-50 percent, a yellow color might be used; from 50-70 percent success, orange; from 70-90 percent, red. The red-orange-yellow is a "win-place-show" type of presentation that can assist landmen in appraising and pricing leases rapidly.

Probability theory may also be explained by everyday references. Take a coin, for instance. When a valid coin is flipped end-over-end, the coin itself has two choices, either heads or tails, and the outcome is uncertain. There is a 50-50 chance of either event occurring, and the entropy is at a maximum in this indecisive stage. When one side of the coin turns up, say heads, then tails cannot occur. These are "mutually exclusive events" in probability theory. A dry hole vs. a

1—(1, 0, 0, 0); 9—(1, 0, 0, 0); 14—(0, 0, 0, 0); 16—(0, 0, 0, 0); 20—(0, 0, 0, 0); 21—(1, 1, 1, 0); 22—(0, 1, 1, 0); 26—(0, 0, 0, 0); 28—1, 1, 0, 0); 29—(0, 0, 0, 0); 32—(0, 1, 1, 1); 33—(0, 0, 3, 0); 38—(0, 1, 1, 0); 40—(0, 0, 1, 0); 41—(0, 4, 0, 0); 44—(1, 2, 1, 2); 46—(0, 0, 0, 3); 47—(1, 2, 1, 2); 50—(1, 1, 1, 1); 52—(0, 2, 0, 9); 53—(2, 4, 2, 4); 61—(1, 1, 1, 1); 62—(2, 1, 1, 2); 64—(0, 0, 1, 0); 67—(0, 2, 0, 8); 68—(2, 2, 2, 2); 70—(2, 2, 3, 3); 73—(0, 0, 0, 0); 74—(0, 0, 0, 0); 75—(0, 0, 2, 2); 80—(2, 4, 2, 6); 83—(0, 1, 0, 1); 88—(2, 2, 4, 4); 92—(0, 0, 0, 0); 95—(0, 2, 0, 9); 100—(1, 1, 2, 2).

TABLE 1—Occurrence of hydrocarbons and porosity in individual horizons in each well is expressed in digital form in an essential step in applying entropy (probability) approach to selection of new drilling locations. Sequence of digits corresponds to productive zones shown in Figure 3. Hole 67, for example, had no porous hydrocarbon-bearing zones in the upper interval, 2 in the next, none in the third, and 8 of 9 zones were porous and hydrocarbon-bearing in the lowermost interval.

producing well is also a mutually exclusive event defined by two choices out of a considerable area of uncertainty.

Similarly, if the reader knew with certainty every word and idea in this article, no information would be conveyed to the reader and the entropy would be zero. Therefore, when a person is unsure of the outcome the entropy is high, but as certainty of an event occurring outweighs the uncertainty, the entropy decreases.

A wildcat well drilled in a new basin where there are no stratigraphic data is starting in at maximum entropy, and the information conveyed to the operator will be great because every foot of rock will be new. As more wells are drilled, some characteristics of the stratigraphic units appear with statistical regularity and certainty, and the entropy begins to decrease.

Statistical mechanics. About 60 years ago, physicists in their study of the second law of thermodynamics (entropy) brought probability theory into play to define what the second law meant with respect to the distribution of gas molecules within a system. This branch of physics is known as statistical mechanics. In effect, what is accomplished is the determination of a probability that a particle or particles exist in a certain cell called a phase space, or element of extension in phase (Figure 1).

In the macrostate made up of four microstates, each microstate is broken up into nine small cells. In some of the cells there is one tiny particle, which could be a molecule. In all, there are 16 particles, 1 in microstate 1, 2 in 2, 5 in microstate 3 and 8 in microstate 4. This complexion from the point of view of thermodynamic probabilities is not very likely to exist with so many molecules in microstates 3 and 4 as compared to the first two. The reader would intuitively conclude that the most probable state is when 4 of the 16 particles are located in each of the four microstates. This is equilibrium, but it is also the value of maximum entropy, which appears to be rather a state of characterless and uniform disorder.

The mathematical derivation of the entropy value of a macrostate can be determined by

$$S = -K \sum_{e=1}^{\infty} w_e \log w_e$$

which is equivalent to the previous formula, and becomes the link between statistical mechanics and information theory.[1,2]

APPLICATIONS IN EXPLORATION

Many observations can be made to link further statistical mechanics and information theory to oil and gas exploration.

First, Figure 1 looks like an oil map with producing wells within certain boundaries or cells. By invoking the binary system of mathematics, which

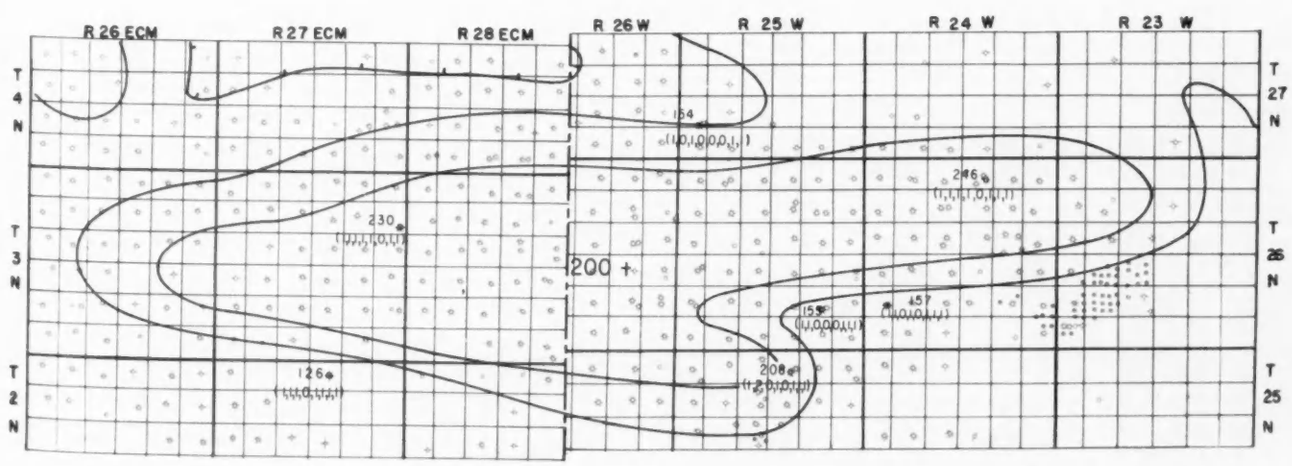

FIGURE 6—Indicated on the base in black is a mere handful of wells and entropy values and contours based thereon; this study was completed more than five years ago. Development since then up to March 1961 is shown in color. This is the vast Laverne gas field, Harper and Beaver counties, Oklahoma, covering more than 250 square miles.

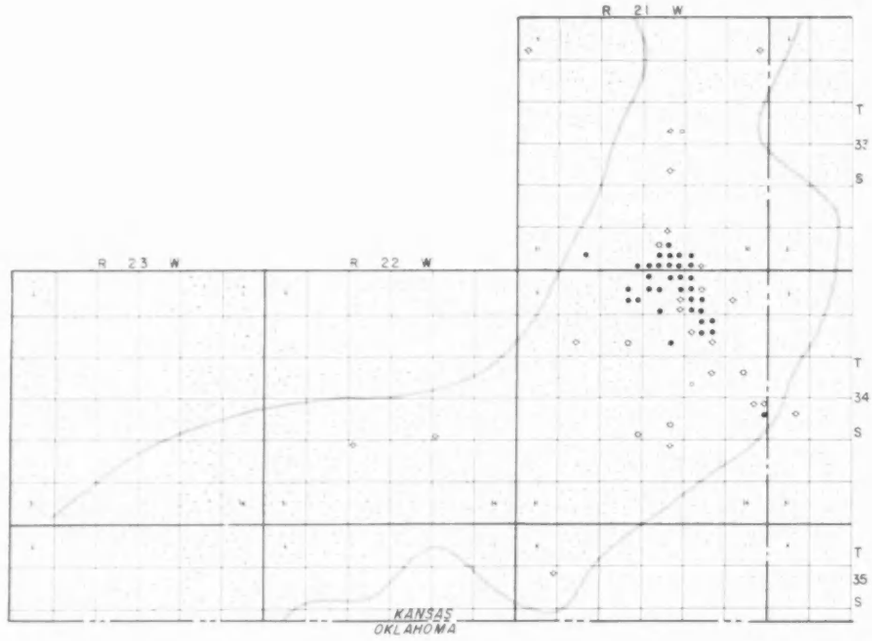

FIGURE 7—This shows drilling results in an area in Clark and Comanche counties, Kansas as of about four years ago, along with electronic computer punch card format type hydrocarbon density map and indicated fairway.

is the convention used in information theory and *has application in the circuitry of high-speed digital computers,* a producer can be imagined as a black dot, and no well (or a dry hole) by no dot. This yields a series of "yeses" versus "nos," existence vs. non-existence, success vs. failure.

According to statistical mechanics, it is possible (though highly improbable) that all the oxygen molecules in an auditorium could collect in one corner leaving the audience to suffocate. To the explorationist, that an occasion of very low entropy could exist whereby all of the hydrocarbons in a county could accumulate in a few hundred cubic yards of rock in one corner of the county, is a situation of very slight probability, too.

Another descriptive example to help illustrate statistical mechanics and the related information theory to the search for hydrocarbons follows. There is a popular television program on which panel members try to determine a guest's occupation or identity by asking questions which require a "yes" or "no" answer. Immediately before the first question, there is a condition of maximum entropy because there are an infinite number of choices of questions to ask first. This is precisely the same condition of the first wildcat in a new basin.

If the panel does well on the first few questions, then the entropy decreases because of the reduced number of choices of essential, remaining questions. Note that the only measurement device is a "yes" or "no" answer! An analogous petroleum geology panel might begin like this:

- Are the rock grains all mixed up with hydrocarbons? No.
- Do permeable horizons number between 10 and 20? Yes.
- Do four or more beds contain hydocarbons? No.
- Do two or more beds contain hydrocarbons? Yes, etc.

Statistical regularity develops from just such breakdown investigations. It is next shown how important this fact is in selecting the next location to drill.

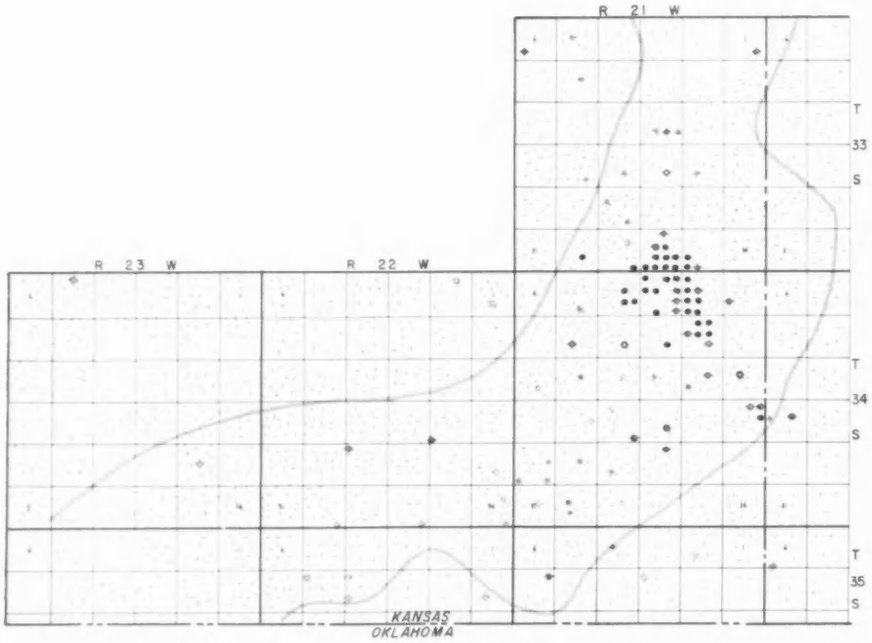

FIGURE 8—Gas discoveries have been made extending fairway indicated in Figure 7 in both directions. Success ratios have been good so far, and much more drilling remains to be done in the fairway.

A subsurface study. An example of a productive area has been created to demonstrate how the entropy concept can be of help to an oil producer in gaining a series of subsurface pictures to increase his knowledge of an area, and to evaluate the merits of several possible locations by studying the relative chances of success.

Figure 2 is a map divided into 100 square areas that could be any dimension, 10 acres, 160 acres, 640 acres, or larger spacing. There are 36 holes, 20 oil producers and 16 dry holes. Of the remaining 64 locations, which

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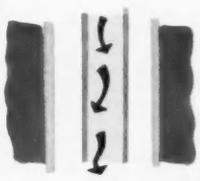
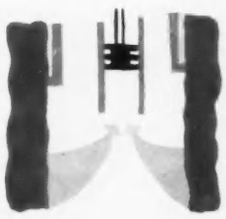


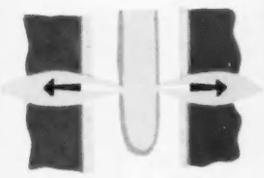
Corrosion inhibitor slugged down tubing

Top-to-bottom "misting" of tubing by nitrified corrosion inhibitor contacts the surface for hours, not minutes. No swabbing-out of fluids. Inhibitor easily squeezed into formation when desired.



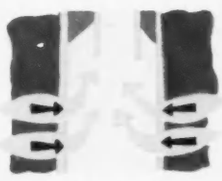
Swabbing-in and drill stem testing

Drilling and well fluids displaced by **Nitrogen**, which is then bled off under control to bring in well. Faster, safer than swabbing . . . ends blowouts, swab loss, cable-scarring of plastic tubing lining.



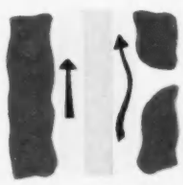
Hydraulic perforating

Co-mingling with Nitrogen increases penetration up to 400%. Especially useful in salt water disposal systems, to increase injectability.



Swabbing-out spent frac fluids and acids

Spent frac fluids and acids pushed out of formation with **Nitrogen** bubbles.



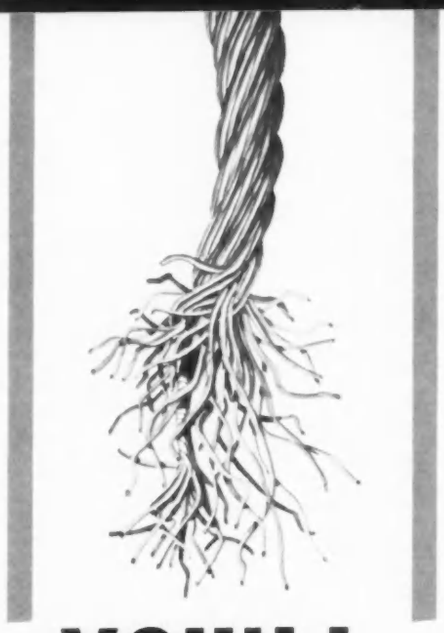
Slow chemical lightening of mud density to combat lost circulation

One-trip reduction of mud density with **Nitrogen** bubbles.

Switching from air to mud when drilling near gas

Add **Nitrogen** to air, preventing down-hole explosions. All-**Nitrogen** drilling is often practical.

NOWSCO Nitrogen cuts completion cost — Job #1712



YOU'LL NEVER LOSE ANOTHER SWAB!

(You won't even use one!)

No need for swabbing when NOWSCO brings your well in.

When this Texas offshore wildcat (see diagram) was completed to two gas zones, the contractor took no chances on blowouts or fishing. He called NOWSCO.

Barged out to the drilling rig at 5:30 AM, the NOWSCO serviceman hooked up and had pressure on the lower completion within 15 minutes! Injecting nitrogen at 3500 psi, he displaced all 8900 ft. of lower-string fluid in 1 hour, then displaced 5000 ft. of the upper string in 35 minutes. Well was brought in by controlled bleeding to atmosphere. *Total time — 2½ hours. Total cost — $740!* In addition:

- Gas flow began several hours sooner
- Saved several hours of expensive rig time
- Saved possible scarring of plastic coated tubing by swab cable
- Eliminated possible swab loss
- No chance of blowout

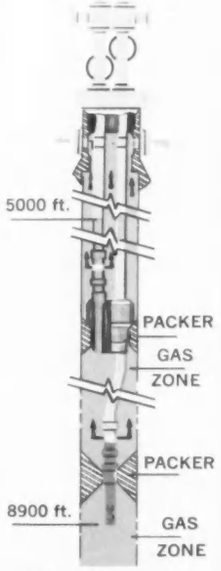
Nitrogen techniques by NOWSCO save money in many other ways — increase penetration of hydraulic perforating, provide inert gas bubbles to push frac fluids and spent acids out of formation, quickly lighten mud column to combat lost circulation, test pressure-tightness more sensitively than with fluid, prevent downhole explosions when gas drilling through pay formations.

NOWSCO Nitrogen comes to your site night or day, in self-contained transport-pump trucks. NOWSCO servicemen are veteran oil field workers thoroughly trained in nitrogen techniques. Backed by more than 1700 cost-saving NOWSCO jobs, they're ready to service your wells with individually calculated injection rates, pressures, volumes.

Want the NOWSCO story on your field conditions? Write or call today for on-the-job case histories.

NOWSCO offers the only complete liquid nitrogen service . . . from manufacture through field application.

NOWSCO service trucks and operators are on 24-hour ready at Houston, Corpus Christi, Perrytown, Odessa, Orange and Lafayette, La.



NOWSCO Nitrogen displaced all of lower string and 5000 ft. of upper string, as shown. Both were brought in by bleeding Nitrogen to atmosphere.

Originator and prime authority on liquid nitrogen techniques . . .

NOWSCO N_2

NITROGEN OIL WELL SERVICE COMPANY
3602 West 11th Street, Houston, Texas
Telephone: UN 4-0965

choice or choices should be made for future wells?

Structural contours were prepared on a persistent limestone marker. One large anticline is dry, and two noses have dry holes on them also. Conversely, two low areas are productive.

Each well is examined in detail in the entropy approach. For simplicity, it is assumed that in each well bore in Figure 2 there are four distinct, correlative lithotopes of sedimentary rocks, bounded by identifiable time lines, and that each of these intervals may be further subdivided into nine equivalent zones that may or may not be porous and contain hydrocarbons. The maximum number of zones and number of intervals are never constant, but are merely treated as such in this case for computational convenience.

Figure 3 shows a hole with the 4 lithotopes and 9 zones in each. The black dots indicate the presence of hydrocarbons. The limestone datum of the structure map lies between lithotopes 3 and 4.

Each hole is given a notation, as shown in Table 1. This means that hole 67 had no zones of porosity and hydrocarbons in the upper interval, 2 out of 9 zones had porosity and hydrocarbons in the second interval, no productive zones in the third interval, and 8 out of 9 zones had porosity and hydrocarbons in the lowest interval.

Referring again to Figure 1, now a similar situation exists by placing all the cells in line so that each hole is made up of groups of cells, microstates and macrostates.

At this point the data (Table 1) are run through the entropy formulas to produce maps found in Figure 4 (information theory) and Figure 5 (statistical mechanics).

Figure 4 (entropy map) is a result of considering each well, and summing the $q_i \log q_i$ values of each interval. As the hydrocarbon content increased from zero in each zone of each lithotope to a value that would be productive, the entropy or disorganization of the information source (the well) decreased. Although it is conventional to work in the binary system, the common logs were used in computing for the map, Figure 4.

Figure 5 (entropy map) is based on wells as macrostates, thence summing up the logarithms of the probabilities of the various complexions due to the presence or absence of hydrocarbon-bearing zones in each microstate (lithotope). These computations were made using Naperian logarithms. The two maps compliment each other, as would be expected.

There are several wells that had measurable porosity and good oil saturation, but because of lack of permeability or unusual relative permeability relationships the wells would not produce. Wells in sections 22, 32, 38, 41, 46, 50, 64 and 83 are in this category and fall between the values of 0 and 200 on the map in Figure 4. The best well on this map is in location 80. So this map suggests that a value above 200 is needed because statistically only 1 dry hole in 14 was drilled when the measure of order or certainty was greater than 200, and this was in location 50.

How many of the 36 wells would two geologists have to select at random before each individual came up with the same statistical picture of the entire area? As an experiment, the author has chosen at random a dozen wells in an area, computed the data, and placed the figures on a map. Then, the process was repeated by selecting a dozen other logs at random from the same area and preparing another map. In some cases which were ergodic in nature, it was astonishing to find how few wells can tip off an entire area for hundreds of square miles, and as additional wells were drilled, the entropy patterns remained essentially constant. Such maps permit forecasting of the statistical chance of success of future wells.

Computers application. The present restriction on the use of entropy-like functions is the immense number of calculations that are usually necessary. Porosity and hydrocarbon values in the separate geological horizons are, of course, determined from a combination of electrical, sound velocity, density, and nuclear downhole logging devices, especially resistivity-measuring sondes. Work is presently under way to program accurately digital computers to yield geologic and engineering data quickly, thus allowing the explorationist to concentrate on interpretation.

CASE HISTORIES

Examples of now highly productive trends outlined several years ago from a minimum of control via the entropy approach are shown in Figures 6 through 9. The areas and the original entropy analyses and wells on which they were based are shown. Superimposed in color is subsequent development through February 1961.

Laverne gas area, Harper and Beaver counties, Oklahoma (Figure 6). The study was completed more than five years ago. According to the map, a maximum value of 300 would indicate gas or oil production in porous zones in all the lithotopes from which electrical log data had been obtained.

One very significant early dry hole was plugged in T3N-R27ECM in 1954 after misinterpretation of the electrical log. Despite the many miles separating the first rank wildcats drilled in this play, a comprehensive subsurface picture showed remarkable statistical continuity.

The still-growing Laverne gas field covers more than 250 square miles and is considered to be the twelfth largest gas field on the North American continent.

Clark and Comanche counties, Kansas. Figure 7 shows the extent of drilling results in this 240-square-mile area as of about four years ago, along with the electronic computer punch card format type hydrocarbon density map superimposed. The original favorable area of fairway was then considered to lie between the two heavy lines. Figure 8 is updated through February 1961 to show development drilling during the 45 months ending then. A number of undrilled sections are indicated as favorable for natural gas, and the further accuracy of this particular analysis will be determined by wells to be drilled in the future. Success ratio to date has been good.

Cimarron County, Oklahoma Panhandle. Figure 9 shows a small but interesting area. When the map (shown in black) was made in the fall of 1957 there was only one well

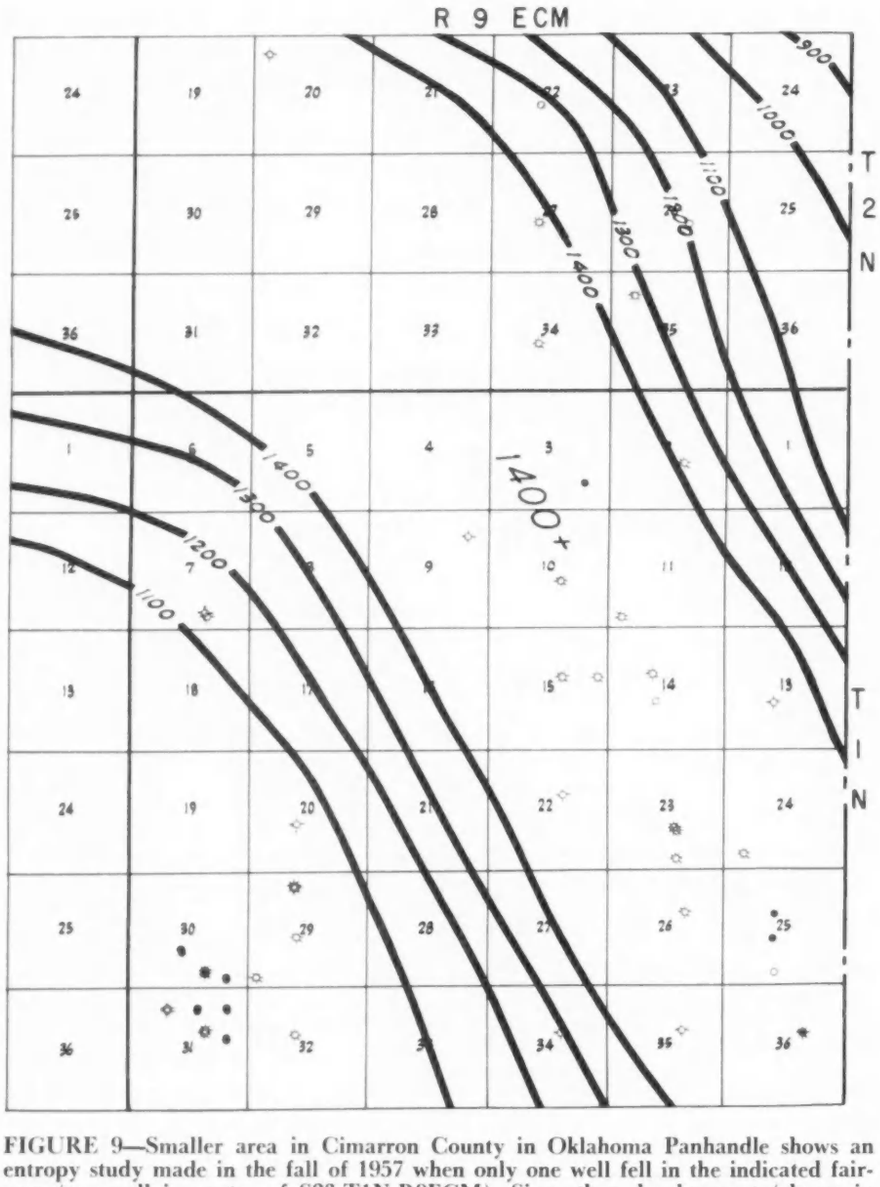


FIGURE 9—Smaller area in Cimarron County in Oklahoma Panhandle shows an entropy study made in the fall of 1957 when only one well fell in the indicated fairway (gas well in center of S23-T1N-R9ECM). Since then development (shown in color) has proven accuracy of the study.

that fell in the indicated fairway. Since then 22 holes were drilled, 17 of them productive, for a success ratio of 77.3 percent. Superimposed in color is the development as of the end of February 1961.

SIGNIFICANCE OF ENTROPY EXPERIENCE

Such statistical methods as are shown here are becoming continually more influential in the current era of rapidly-changing technology. A number of major oil companies are working along these lines in one way or another, *but this by no means eliminates the independent producer from taking advantage of this approach to exploration and development.*

This method is in accord with the modern tendency to reduce geological and geophysical data to digital form for processing in electronic computers and other electronic plotting and data-processing gear. Also, since the conventional search for structures is not stressed in this approach, the entropy method appears to be unusually effective in finding hydrocarbons in stratigraphic traps.

Many technical exploration men would conclude that the thorough zone-by-zone analysis converted to digital terms in this article is simply another way of doing what a thorough and conscientious subsurface geologist does (in graphic form) whenever his time allows. This is largely true.

However, it is conceivable that one individual feeding subsurface data into a medium or high-speed electronic computer might choose more good drillable prospects in a year than could all the oil geologists in the United States put together. This thought causes discomfort at first. But no company has enough funds to drill all the prospects it would like to, so that the net result will be to increase both competition and profits simultaneously in the industry for those who are willing to accept technological change.

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About the Author

John P. Dowds is general manager and partner of The Anabaco Operating Company, an independent oil and gas producing firm in Oklahoma City. He is also a director of the Texinia Corporation. Dowds is a geologist and a registered engineer. A native of Montclair, N.J., he graduated from Massachusetts Institute of Technology in 1951, and worked for six years thereafter for Kerr-McGee Oil Industries, Inc. in exploration for and development of oil, gas, helium and uranium throughout North America. He is a member of AIME and AAPG. During World War II he served in the Atlantic-European, Mediterranean-Middle East and Asiatic-Pacific theaters, and is a U.S. Air Force Reserve officer in the communications engineering and installations field.

Gas drilling reduces costs in Mississippi

New circulating medium saves Shell 70½ drilling days, $100,000 total costs, 93 bits and $10,000 in circulating medium costs

By J. N. Howell, Mechanical Engineer,
Shell Oil Co., Jackson, Miss.

IN THE FIRST PART of 1958, Shell Oil Company completed the Jarrett et al Unit 1 as a gas discovery well in the Siloam Field, Clay County, Mississippi. Though this well had an open flow potential of 6.4 MMcf per day and a shut-in tubing pressure of 3,000 psig, it was shut-in upon completion because a gas market was not available.

In view of the high drilling costs in this field, an analysis of the drilling experience was made to determine if modifications in drilling techniques might enhance the economics of a development program in this area. This study indicated that a savings over the best cost using mud might result if a well were drilled to 8,700 feet using air as the circulating medium. Available subsurface information indicated that an air or gas drilling test might be successful to 8,700 feet in the Siloam Field in view of the low permeability zones to be penetrated.

Gas was selected over air as the circulating medium because:

- High pressure gas available from the Jarrett well required no compression.
- Out-of-pocket cost of this gas to Shell amounted to only royalty payments and taxes.
- Production of gas from the Jarrett well would permit a desired test which would further evaluate the reservoir.

General procedures. Gas drilling was found to be similar to mud drilling in many ways. However, due to differences in the circulating medium and the special equipment required for gas drilling (See Appendix A), some operations were performed differently while gas drilling (See Appendix B).

Drill pipe connections were made in the following manner:

The gas supply going down hole was bypassed to the flare pit through the blow line and the drill pipe pressure was bled to less than 5 psig before breaking the connection. The connection then was made in the normal manner. The practice of bypassing the circulating gas was discontinued at a depth of approximately 3,000 feet, the gas supply to the hole was merely turned off at the gas manifold while making a connection and the drill pipe pressure bled off as before.

The rotating drilling head is the major item of gas drilling equipment. The rotating seals must be continuously lubricated and the rig must be accurately aligned over the hole to minimize wear on the rotaing head rubbers and bearings. The seal rubber should be continuously lubricated while drilling. This was achieved by pouring a light lubricating oil on the rubber while drilling. Since there is no way to lubricate the rubber from below, it should be maintained in as good a condition as possible. Rubbers were changed immediately upon showing signs of leakage. Rotary speeds were limited to 60 rpm to prevent excessive wear on the rotating head.

Reamers, stabilizers and bits cannot be stripped through the rotating head. So, when making a trip in a hole producing gas, the bit was pulled above the blind rams and the rams were closed before removing the rotating head. Sufficient space was provided between the rotating head and the blind rams to accommodate all items in the hole which could not be stripped through the rotating head.

Anticipating a gas show at approximately 4,000 feet, stabilizers were purposely omitted from the drill string and rubbered drill pipe was removed before reaching this depth. Tripping in a hole that is not producing gas is accomplished in the normal manner and the rotating head is removed with the first joint of drill pipe.

Drilling program. An 18-inch conductor hole was drilled to 77 feet with mud, and two joints of 16-inch spiral weld casing were cemented at this depth with 75 sacks of neat cement.

A 15-inch surface hole was drilled to 1,607 feet and 10¾-inch, J-55, 40.5 pound casing was cemented at this depth with 450 sacks of common cement plus 8 percent gel and 100 sacks of neat cement. Fifty yards of pea gravel in the annulus stabilized the surface casing. Large (10¾-inch) surface casing minimized drill pipe wear and permitted the use of non-rubbered drill pipe.

A 9⅞-inch shale bit was used to drill the float collar and cement in the surface casing to a depth of 1,605 feet. Mud was displaced with water and the water was displaced with gas prior to drilling the float shoe. The hole was dried by blowing with gas for approximately 15 minutes before drilling the shoe.

When the shoe was drilled, the well started dusting immediately. A damp zone was encountered from 2,243 to 2,280 feet. The hole began dusting again at 2,280 feet and continued to dust to 3,550 feet.

The hole was wet after a trip at 3,550 feet and after drilling two joints down without returns, it became necessary to slug the hole with two gallons of a foaming agent and seven barrels of water to clean the hole. Dust was never recovered during the remainder of this well, and the practice of slugging with 1 to 3 gallons of foaming agent and 5 to 10 barrels of water every 60 feet was adopted to prevent sticking the pipe. No attempt

Installation time for

–25 seconds per joint

Water flood system installed at speeds up to 880 ft. per hour

Outstanding success with Du Pont **DELRIN** acetal resin pipe has been reported throughout the oil patch. Typical of this experience is a water flood system recently installed in Kentucky. Twenty-two 1½" flow lines were installed at speeds up to 880 feet per hour. Most joints were made within 25 seconds, using the simple, fast integral joining method based on heat fusion.

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DELRIN pipe was developed by Du Pont specifically for use in oil and gas production. It is manufactured, sold and serviced by the Du Pont Company. Here's why **DELRIN** pipe can offer the economy of long, trouble-free service:

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- ***It resists corrosion,*** both internally and externally, and it resists paraffin build-up under most field conditions.
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1 Operator clamps the cold ring around the pipe at point indicated by depth gauge, while helper aligns pipe. This ring insures proper insertion of the pipe into the coupling during the heating operation.

2 Pipe is inserted into female die of heating tool, a lightweight unit powered by a portable generator or other electricity source. Coupled end of pipe is being heated by male die of the tool.

3 After 15 seconds, tool is removed and the pipe end is quickly pushed into the coupling until the cold ring touches the face of the coupling. Both operators align pipe to be sure joint is straight.

4 Within 10 seconds, the molten resin has solidified to give a leak-free integral joint. Pipe may be tested at pressures up to 150% of the rated pressure. Total joining time: 25 seconds.

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was made to dry the hole with drying agents.

Water entry into the well bore was detected by the loss of dust returns and damp cuttings in the sample catcher. The wet hole and the practice of "slugging" with foaming agent and water every 60 feet caused considerable sloughing and erosion of the shale section. Pipe was stuck on numerous occasions, but was freed by additional slugs of foaming agents and water.

Drill pipe stuck 380 feet off bottom while tripping at 4,701 feet. The pipe was run back to bottom, and the hole was slugged with 3 gallons of foaming agent and 8 barrels of water. After blowing the hole with gas for 30 minutes, the pipe was started out of the hole a second time and it again stuck 390 feet off bottom. At this point, the hole was slugged with 3 galllons of foaming agent and 8 barrels of water and blown for 30 minutes. The pipe then was pulled with no further trouble.

On the next trip, at 6,229 feet, the drill pipe again stuck while being pulled. However, this time the hole was cleaned with 1 slug of 4 gallons of foaming agent and 8 barrels of water injected at 6,229 feet. Similar trouble was encountered at 7,824 feet and again at 8,792 feet. Prior to beginning each trip, the hole was slugged with foaming agent and water.

While going in the hole after a trip at 7,828 feet, the bit was inadvertently rammed into a tight spot at 7,638 feet. The pipe could not be worked or rotated. Five gallons of foaming agent and 20 barrels of water were injected and the bit came free. However, the lining of the rubber rotary hose came loose and plugged the bit at this point. While pulling to change bits, a tight spot was encountered at 6,538 feet. The bit was pulled through a 15-foot bridge by rotating while maintaining a steady pull of approximately 20,000 pounds above the weight of the string.

The angle of deviation reached a maximum of 4 degrees at a depth of 4,500 feet. The angle dropped to approximately one degree at 5,000 feet and remained essentially constant for the remainder of the hole.

Survey instruments were run on a wire line for two reasons. First, numerous shots were made without tripping to recover the instrument. Second, a survey instrument dropped in a dry pipe would shatter.

The angle in the surface hole at a depth of 1,600 feet was two degrees and was building up. Consequently, during the first bit run below surface, the weight on bit was reduced to approximately 8,000 pounds. However, the light weight did not reduce the angle, and the weight was increased to approximately 18,000 pounds for the duration of the gas drilling operations.

It is interesting to note that although no further attempts were made to control the deviation, the angle of deviation was almost identical to the deviation experienced while mud drilling the Jarrett et al Unit 1 to 4,500 feet and was even less at depths below 4,500 feet. This is interesting in that stabilizers and weight control were utilized to control the deviation in the Jarrett well, but due to the problems of stripping stabilizers from a gas producing hole, none was used while gas drilling.

The stand pipe pressure varied from 120 psig to 275 psig, depending upon nozzle openings. The highest pressure, 275 psig, was experienced when bit 6 became plugged with pea gravel.

Although the driller relied upon the stand pipe pressure to a great extent, volume of gas rather than the pressure was the important variable. Rates were adjusted at the beginning of each new bit run to approximately 2.5-3.2 MMcf per day letting the stand pipe pressure reach any value required to maintain the given rate. These rates were based on maintaining an annular velocity of 3,000 feet per minute while drilling dry and 4,000 feet per minute while drilling wet.

The shale section drilled considerably faster than the sand section. Penetration rates in shale varied from 30 to 46 feet per hour while the sands drilled at 5 to 15 feet per hour. A better correlation existed between the rate of penetration plots and the resistivity curves than between the penetration rates and the potential curves, a fact which might be useful in picking depths while drilling future wells in this field.

The bit life could not be predetermined or regulated by the bit manufacturers' recommendations. The degree of wear was noted to be dependent to a large extent upon quantity of abrasive sands drilled. A torque gage and firsthand knowledge of the hole condition were found to be the only reliable "yardstick" by which useful bit life could be measured.

Electrical logs and drilling records of the neighboring well, Jarrett et al Unit 1, and a plugged and abandoned well to the south, indicated a possible gas sand at approximately 4,400 feet. Rubbered drill pipe was removed from the string prior to reaching this depth and precautions taken to eliminate everything such as reamers and stabilizers from the drill string which could not be stripped out of the hole in the event the hole started producing gas.

These precautions proved justifiable inasmuch as a gas sand was encountered at approximately 4,760 feet, which flowed on a choke test at approximately 2.5 MMcf/D. This zone continued to produce at this rate while drilling the remaining 4,032 feet of gas drilled hole. Drill pipe and collars were stripped in and out through the rotating head during all subsequent trips as described previously.

Gas drilling was terminated at a depth of 8,792 feet when the drill pipe became stuck while tripping out and it was necessary to mud up to free the pipe. The well was mudded up by backing the drill pipe off at 7,800 feet and killing the well by reverse circulation. No difficulty was experienced in killing the shallow gas flow. The hole was deepened to 8,893 feet, using mud as the circulating medium.

Bits. The first bit used in the gas drilled interval was a 9⅞-inch soft formation bit. The purpose of this bit was to drill cement and float equipment from the surface casing. However, after drilling cement, this bit was left in the hole as a semi-experiment to determine its capabilities while gas drilling. This bit drilled 516 feet of hole in 18¾ hours with no appreciable tooth wear. However, the bearings were filled with sand and grit and the cones were on the verge of locking.

The remaining bits used in the gas drilled interval were 8¾-inch tungsten carbide insert, "button" bits. These bits were designed especially for air and gas drilling; i.e., a portion of the circulating fluid was diverted through the bearing housing to keep dust and grit from entering therein. These bits were also constructed with "buttons" on the sides of each cone. The purpose of these buttons is to minimize gage wear. Effectiveness of

the gage buttons was demonstrated when new bits were run to bottom without reaming.

Two regular bits and six jet bits were used. The regular opening bits were severely eroded by the gas stream impinging upon the cone surface. Only slight erosion was experienced with the jet bits. However, some difficulty was experienced with plugging of the jet nozzle with gravel and rubber.

The "shirt tail" wore through on most of the gas bits exposing the bearings. However, bearings were lost from only one cone on one bit. All worn bits except bit 7 were from $\frac{1}{16}$-inch to $\frac{1}{8}$-inch out of gage when gaged "cone up." When gaged "cone down" with weight applied, these bits were less than $\frac{1}{16}$-inch out of gage.

Bit 7 was badly eroded with the 13 apex inserts washed from the lead cone. The bit was $\frac{3}{8}$-inch under gage. Believing the hole to also be out of gage, a blade reamer was run 15 inches above the bit on the next bit run (Bit 8). The reamer was run approximately 22 hours without reaching bottom. When the reamer was pulled, it was found to have lost the hard facing from two blades. The bit was relatively unharmed and was re-run reaching bottom after washing down the last 300 feet in approximately two hours.

A close examination of bit 7 indicated that although the bit was $\frac{3}{8}$-inch out of gage, it was not under gage due to hole wear but apparently was damaged by the loose "buttons" in the hole. This was also indicated to be the situation when bit 8 was re-run without difficulty after removing the reamer from the drill string. A copy of the bit record is shown in Table 1.

Economic evaluation. Figure 1 is a comparison of the total drilling time for the mud drilled Jarrett et al Unit 1 and the Cottrell et al Unit 1 which was drilled with gas.

The gas drilled well required 30.5 total days to reach 8,792 feet. Included in this time is 2 days rigging up time and 1 day lost time due to gas line freezing. Therefore, the total chargeable rig days to reach 8,792 feet was only 27.5 days. The Jarrett well required 107.5 total days to reach the same depth. This time included 2 days of non-chargeable rig repairs and 5 days lost time due to high water.

Drill stem testing and coring are necessary when mud drilling, but in gas drilling the formations are essentially being tested continuously while drilling, thereby reducing the additional rig time required for these operations. Therefore, the total time involved in mud drilling to 8,792 feet was 100.5 days, which included DST and coring time. The apparent reduction in rig time with gas over mud is then 73 days. The actual savings in rig time when equated to the gas drilled interval from 1,607 feet to 8,792 feet is 70.5 days.

Twelve bits were used to drill the Cottrell well to 8,792 feet. Three of these were used to drill the conductor and surface holes and nine were used in the gas drilled interval. The Jarrett well required 107 total bits to drill to 8,792 feet and 104 bits in the interval 1,538 to 8,810 feet. Although the number of bits used while gas drilling was considerably less than the number used while mud drilling, the bits used for gas drilling cost approximately $1,084 each as compared to $208 each for the mud bits.

Mud costs in the interval 1,607 to 8,792 feet in the Jarrett well were assumed to consist of two break overs at $2,500 each and a maintenance

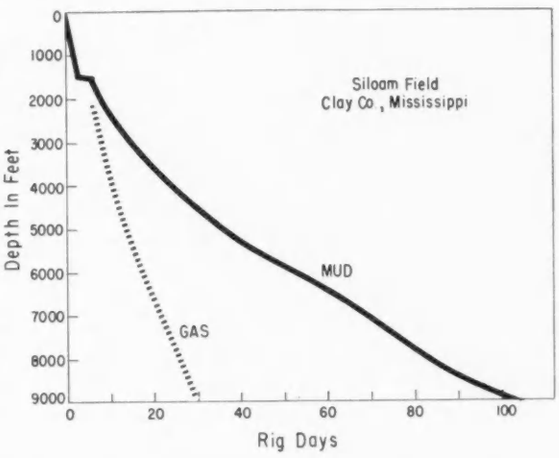

FIGURE 1—A comparison of total drilling time for mud and gas-drilled holes.

cost of $150 per day. Out-of-pocket gas costs in the same interval consisting of taxes, royalties and joint venture share amounts to approximately $57.61 per MMcf.

Assuming equitable daywork costs and drill pipe rental, the savings realized in the interval from 1,607 to 8,792 were as follows:

	Mud	Gas
Drilling Costs	$100,610	$23,220
Bits:		
104 @ $207 each	$ 21,500	
9 @ $1,084 each		$ 9,750
Mud:		
$5,000 + 95 days × $150/Day	$ 19,250	
Gas:		
Foaming Agents	—	$ 2,040
2.5 MMcf/D × $57.61/MMcf × 22 Days	—	$ 3,170
Standby and Kill Mud	—	$ 3,000
Cost to rig up to gas drill		—0—*
Total	$141,360	$41,130
Savings	$100,000	

*No charge is indicated as the facilities were needed to supply rig fuel (or alternatively, if butane were used, the daywork rates would be higher). In addition, all items were returned to stock with only possible minor charges to the well.

Discussion. Penetration rates with gas were considerably better than when mud was used as the circulating medium. A tabular comparison of the rotating hours and footage drilled is as follows:

	From	To	Feet	Hours	Ft./Hr.
Jarrett (Mud)	1,904	8,810	6,838*	1,420**	4.81
Cottrell (Gas)	1,607	8,792	7,185	310	23.18

* 68 feet deducted for coring.
** Coring hours not included.

Penetration rates while gas drilling were 4.82 times as great as the pene-

TABLE 1—Bit Record Shell Cottrell Unit No. 1, Siloam Field, Mississippi

No.	Size	Nozzle Type	Footage	Hours	1000 Lb. Weight	RPM	Pressure	Fluid
1	18″		77					Mud
2	15″	Jet	1203	18	25	110	1000	Mud
3	15″	Jet	327	19	20	100	1000	Mud
4	97/8″	Regular	516	18¾	8	60	125	Gas
5	8¾″	Regular	1427	58¾	15	60	125	Gas
6	8¾″	Jet	1151	65½	15	60	275	Gas
7	8¾″	Regular	1371	72	18	55	120	Gas
8	8¾″	Jet	157	9	15	55	120	Gas
9	8¾″	Jet	536	36¼	20	55	125	Gas
10	8¾″	Jet	1053	50	25	60	120	Gas
11	8¾″	Jet	655	36½	20	60	175	Gas
12	8¾″	Jet	319	25	25	55	170	Gas

tration rates achieved while mud drilling.

Washing or metal erosion on the regular opening bits was severe and while some erosion occurred with the jet bits, it was slight. An explanation of this might be that the gas stream from a regular opening bit impinges directly on the bit cones blasting out the metal while the gas stream from the jet bit impinges on the bottom of the hole. The slight erosion occuring on the jet bit cones could result from gas turbulence at the face of the cone adjacent to the hole bottom.

Plugging occurred with three jet bits. One bit was partly plugged with pea gravel (source unknown) and two were plugged or partly plugged with pieces of the rubber lining from the rotary hose.

Although only one non-air bit was used while gas drilling, presence of sand and grit in the bearing of this bit compared to the absence of grit in the air bits indicates that only when grit is kept out of the bearings can the bit be expected to last for a great length of time. The shirt tails were worn off several of the air bits, but the bearings were remarkably free from grit and wear. It should be pointed out that in a gas drilled hole, the bits were not lubricated or cooled except by gas and the lubricating properties of gas are questionable. Hence, the bearing life is determined solely by the extent to which the bearings are kept clean and cool.

The circulated gas did not contain any appreciable amounts of aromatics which would tend to deteriorate the rubber lining of the rotary hose. It is believed that the hose was old and would have failed even in mud service.

When the hole was discovered "wet" after the trip at 3,550 feet, no attempt was made to dry the hole either by blowing or treating with drying agents. After drilling 60 feet with no returns, it was necessary to remove the cuttings then generated. This was accomplished by batching or "slugging" foaming agent and water into the hole and blowing the hole with gas until the water was discharged from the hole. Slugging continued every 60 feet for the remainder of the gas drilling operations. However, on several occasions after the hole became wet, the discharge from the blowline appeared to contain dry dust.

Exceptionally large pieces of shale were ejected from the hole during each slug, indicating possible hole damage. However, a caliper survey indicated that hole erosion in the Cottrell well was no greater than that in the mud drilled well. In both wells considerable hole enlargement was noted in the shale sections. No enlarged sections occurred within the sands.

The seven-inch blowline contained two 45-degree miter joints adjacent to the rig and a 15-degree miter joint on the flare end. The miter joint at the flare pit was installed to divert the flare downward into the flare pit to prevent blowing the flames across the pit into heavy woods. This diverter was cut completely out by the abrasive action of the cuttings. Similarly, one of the 45 degree turns at the rig started leaking during the last

About the Author

J. N. Howell received B.S. and M.S. degrees in petroleum engineering from The University of Texas in 1954 and 1956. He has been with Shell Oil Company in Louisiana and Mississippi since 1956 as a mechanical engineer. He is a registered professional engineer and is a member of Tau Beta Pi and AIME.

APPENDIX A

Rig Equipment

A conventional rotary drilling rig was adapted to gas drilling with only a few modifications. The major equipment required for gas drilling are as follows:

1. Blowout preventer assembly consisting of the following:
   A. A combination rotating blowout preventer and stripper with 10-inch API Series 900 lower flanged connection, 7-inch API Series 900 flanged side outlet, complete with kelly drive unit and automatic pressure lubricator.
   B. A 10-inch Series 1500 hydraulic double ram blowout preventer, equipped with "blind" rams on top and 4½-inch rams on bottom, complete with 4 handwheels, extension wrenches and universal joints.
2. Two sets of hydraulic blowout preventer controls in the following locations:
   A. One set shall be located on the rig floor convenient to the driller's stand.
   B. One set shall be located 150 feet from the rig floor.
3. A seven-inch blow line from the rotating head to the flare pit. The minimum length of this line is 300 feet. This line should be securely supported and anchored throughout its length.
4. A four-inch test line from the choke manifold to the flare pit with an orifice well tester installed on the pit end of the line.
5. An auxiliary piston pump for use in injecting liquid chemicals into the gas stream. This pump should be capable of injecting as little as one barrel per hour with a calibrated mixing tank of at least ten barrels capacity, and should be inst[illegible]d downstream of the rig fuel [illegible]n the gas supply line.
6. A ga[illegible]age in the stand pi[illegible]n clearly visible f[illegible] stand.

[illegible]t in the flare pit at [illegible]of the blow line. Gas for [illegible]ot light should be taken the rig fuel volume tank.

8. A sample trap and catcher in the blow line.

few days of the gas drilling operations.

The baffle in the sample catcher was sand blasted through at the completion of the gas drilling operations. However, samples collected during the last days were workable samples and possibly were trapped in the catcher because of the turbulence created in the sample trap and possibly because they were wet and were being rolled along the bottom of the blowline and gravitated into the trap. The wet samples were in every instance larger than the dry samples.

The freezing problems occurring in the flowline from the Jarrett et al Unit 1 to the Cottrell et al Unit 1 probably resulted from a combination of factors.

- The liquid content of the gas in this line was exceptionally high.
- The quantity of methanol injected was based on Jacob's method for determining the amount of methanol required to prevent freezing and the initial gas analysis of the Jarrett production.

The atmospheric temperature was in the low twenties, which was considerably lower than the anticipated temperatures.

In view of the physical and economic success ($100,000 savings) of this gas drilling trial, it might well be expected that similar operations should be attempted on future wells in the Siloam Field, and possibly to other fields and/or wildcat wells in the Black Warrior Basin of Mississippi and Alabama.

The success of the gas drilled trial was largely due to the contract drilling crews which were selectively screened by the contractor. Each crew contained two drillers, one experienced with gas drilling operations and one an experienced mud driller. All crew members, except two, the extra driller and one floorman, had previous gas drilling experience.

Recommendations

1. Production facilities for future gas drilling operations should, when possible, be located at the source well to minimize freezing problems.

2. No ells or turns should be permitted in the blow line regardless of the height of this line at the rig. A straight line with a downward slope towards the flare pit is desired.

3. The sample catcher should be equipped with a rotating baffle which can be removed from the flow stream when not in actual use.

4. An attempt should be made to dry up the hole any time it is found "wet" after a trip. Drying agents should be tested for this purpose in the Siloam Field.

5. "Slugging" the hole with foaming agent and water should be avoided whenever possible. However, in the event two joints are drilled without returns, it is recommended that the hole be cleaned by "slugging" before proceeding.

6. Consideration should be given to squeezing those water flows which cannot be dried up by blowing with gas or dusting with drying agents.

7. Jet bits (with two nozzles removed) are recommended.

8. Tungsten carbide insert "button" bits with the side mounted gage buttons are recommended.

9. Rotary hose should be in good condition. Steel swivel joint hose is preferred.

10. All bits should be equipped with gas passages to the bearings.

11. Gas injection rates should be regulated by velocity and not by standpipe pressure. Adjust gas rates to yield an annular velocity of 3,000 fpm. The choke should be adjusted in accordance with orifice meter reading.

12. A pressure recorder should be installed on the stand pipe to record fluctuations in air or gas drilling pressures to determine rate of fluid entry.

---

9. A two-inch release line from the stand pipe to the flare pit to bleed pressure off the stand pipe before breaking off the kelly for a connection (See Figure 2).

10. A two-inch bypass line from the gas supply line to the blow line to maintain gas circulation in the blow line to prevent flame propagation in this line while making a connection.

11. A drill collar float in the event high pressure formations are drilled into and also to reduce bleed-down time when making a connection. The float should be added to the bit sub.

12. A drill pipe stabber to guide drill pipe into the stripper rubber.

13. An explosimeter for use in detecting gas leaks.

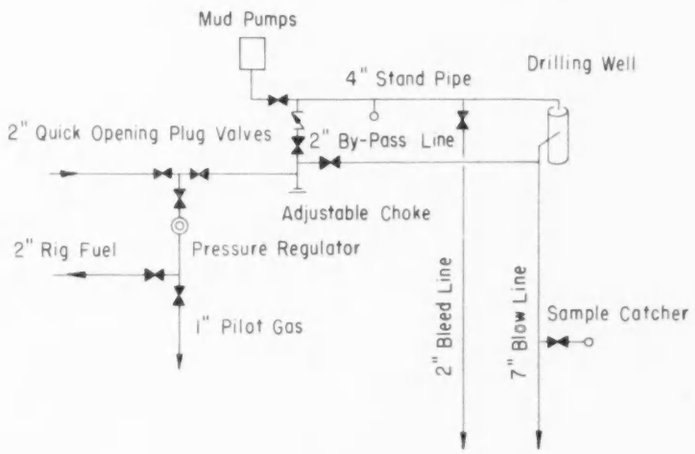

FIGURE 2—Piping diagram for gas drilling

The BOP assembly was installed as shown in Figure 3. The spool between the top ram preventer and the rotating head was inserted in the assembly to provide sufficient stripping space between the rotating head and the blind rams as will be explained elsewhere in this report.

The gas supply to the stand pipe, the gas bypass, and the drill pipe bleed line were consolidated into a simple gas manifold as shown in Figure 4. This manifold was located at ground level adjacent to the rig substructure and grouped all gas controls at a single point.

The sample trap and catcher were fabricated in accordance with Figure 5 and installed in the seven-inch blow line approximately 150 feet from the rig. This trap performed satisfactorily while drilling the Cottrell well. Although the baffle plate cut out, the samples collected were of sufficient size and quantity to perform normal ditch cutting analysis.

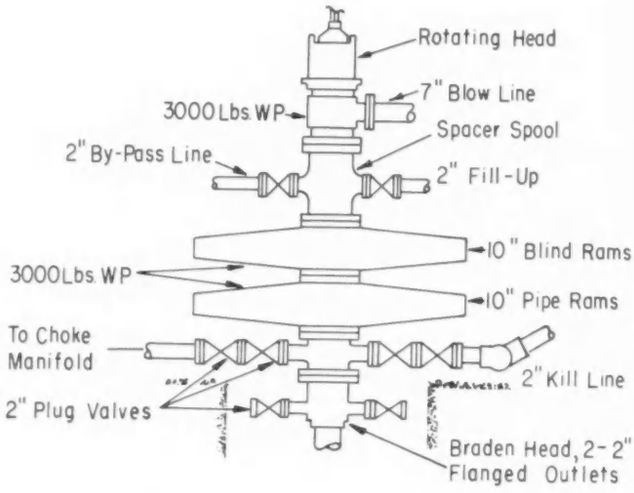

FIGURE 3—Blowout preventer hookup for drilling with gas.

APPENDIX B

Safety Precautions

The use of gas as the circulating medium while drilling made it necessary to institute and enforce many safety precautions to protect against surface explosion and to provide personnel safety. Accordingly, an itemized list of safety precautions was prepared prior to spudding the Cottrell well. This list was distributed to all personnel visiting or working on this well. The safety precautions observed while gas drilling the Cottrell et al Unit 1 well were as follows:

1. *No person* will be allowed to have matches, cigarette lighters, or any other flame or spark producing mechanism in their possession while on the rig floor. Such items of ignition are to be left in automobiles or in the doghouse.

2. Personnel must stay clear of the discharge from the seven-inch blow line at all times.

3. Automobiles will be parked in a designated area 300 feet from the derrick floor. Only vehicles handling heavy equipment will be permitted beyond this point. These vehicles must obtain clearance from the driller or other authorized persons before proceeding into the danger zone.

4. In case of fire, all personnel are instructed to protect their eyes and attempt to hold their breath until out of the burning area.

5. Visitors will not be allowed within 300 feet of the rig floor unless accompanied by authorized personnel.

6. Signs will be posted on the road leading into the location stating: "Visitors Are Not Allowed Beyond This Point." These signs shall be placed 300 feet from the rig floor.

7. There will be sufficient passageways from the derrick floor so that all employes can escape in an emergency. These passageways shall be kept open and free of all objects at all times.

8. All unnecessary equipment will be removed from the rig floor.

9. Good housekeeping practices will be followed at all times.

10. A maximum amount of fire fighting equipment will be on hand. Suggested equipment is: three 30 pound dry chemical extinguishers on the rig floor; one 30-pound chemical extinguisher near the light plant; one 350 pound dry chemical extinguisher on ground near substructure; one 150 pound dry chemical (nitrogen charged) "Fire Boss" manifolded under the rig floor with 150-foot hand-operated hoses.

11. Drilling crews will have regularly scheduled fire drills and be taught how to use the fire fighting equipment which is available.

12. The BOP and circulating head will be of standard make and be kept in first class condition. This equipment will be inspected frequently and crew members should be taught how to use. BOP drills will be held regularly.

13. The stripper rubber in circulating head will be inspected frequently and if there are any leaks, changed out immediately.

14. All connections, union, etc., will be constantly inspected for leaks and if any are found, corrected immediately. An explosimeter shall be used to detect gas leaks.

15. Gas will not be allowed to accumulate on the rig floor or

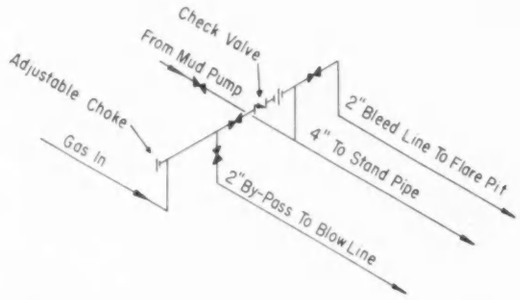

FIGURE 4—Schematic diagram of the gas manifold that was used successfully.

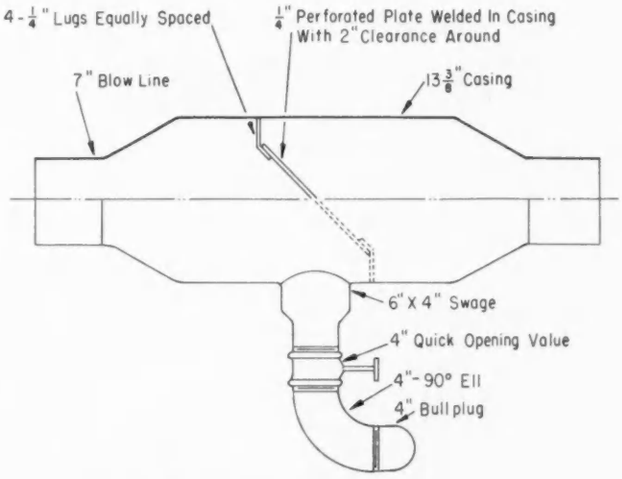
4-¼" Lugs Equally Spaced
¼" Perforated Plate Welded In Casing With 2" Clearance Around
7" Blow Line
13⅜" Casing
6" X 4" Swage
4" Quick Opening Value
4"-90° Ell
4" Bull plug

FIGURE 5—Sample catcher is shown attached to the blowline. Good samples were obtained with this catcher throughout the entire drilling operation.

under the substructure. This can best be eliminated by using large fans (bug blowers) to dissipate gas, if any should happen to accumulate.

16. All chain guards will be solidly built and oil bathed.

17. To prevent any sparks which could ignite gas, spinning rope will be substituted for spinning chain; tool joints doped and kelly bushings well greased to prevent heating, and rotary clutch adjusted to provide slippage for torque control.

18. Provision will be made for derrickman to escape by using a wireline and buggy.

19. A specific crew member will be designated to close the shut-off valve on the gas line leading to the rig in the case of emergency. This man will be stationed in the vicinity of the shut-off valve while drilling is in progress.

20. The pilot light will not burn while making a trip; therefore, after returning to bottom with drill pipe, assurance will be taken that all air is out of flow line before lighting pilot light.

21. Safety meetings will be held by each driller at the beginning of each tower. The dangers of gas drilling and the individual crew members responsibility in case of emergency will be reiterated at each meeting.

22. Crew members shall be instructed in the operation of all valves tying the gas and mud systems together, specifically those valves on the stand pipe.

23. Welding will not be performed around the rig while circulating gas. Open fires will not be allowed within 150 feet from the derrick floor.

24. Rig engines must be spark-proof and the engine exhaust must be directed through a water spray. These two considerations should be checked each tower.

25. Vapor-proof rig lighting will be used. Wind breaks will not be used around rig floor or engines.

26. The seven-inch flow line will be anchored securely. The discharge from this line shall be 300 feet from the rig floor.

27. A single magneto-grounding switch will be located at a convenient location to shut down the rig engines in case of emergency.

28. A pilot flame shall burn in the flare pit at all times while drilling. This flame shall be extinguished while making a trip (see No. 20 above).

29. Doghouse, trailers, light plants, etc., shall be located a minimum of 150 feet from the derrick floor.

30. Rig mud pumps will be tied into the BOP manifold on rig floor with 2-inch tubing and HP fittings.

31. Mud and water tanks are to be kept full at all times.

32. In the event of a down-the-hole explosion, hot gases may emit from the hole for several seconds with probable damage to the rotating head. If it is suspected that such an explosion has occurred, presume that the head may fail and move clear accordingly.

ACKNOWLEDGMENT

The author wishes to express his appreciation to Shell Oil Company for permission to publish this article and to Rowan Drilling Company, Incorporated, for cooperation and guidance while planning and executing the gas drilling program.

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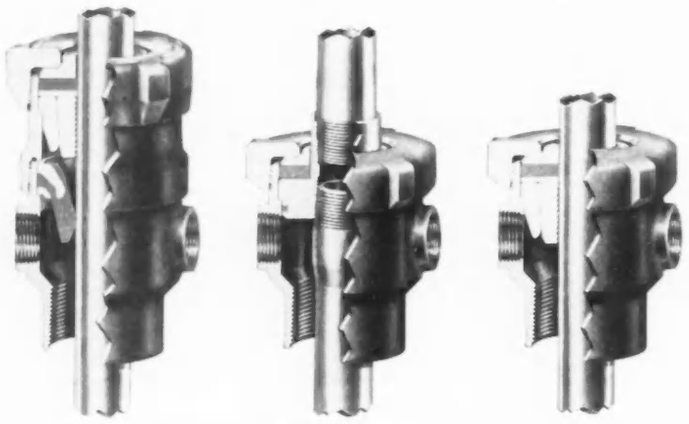
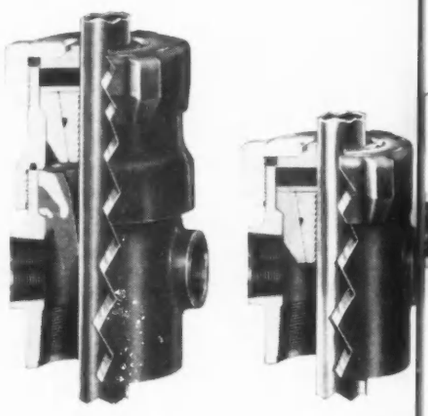
1000 — P. S. I. Working Pressure



TYPE SK TYPE MK TYPE K

2000 — P. S. I. Working Pressure



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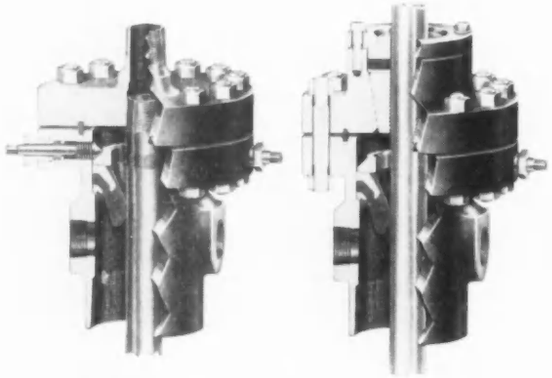

FIG. 612 MANDREL TYPE

FIG. 612 SLIP TYPE

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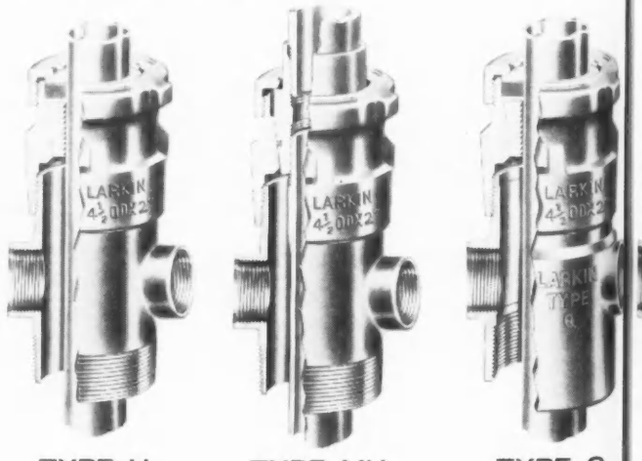

TYPE H TYPE MH TYPE Q

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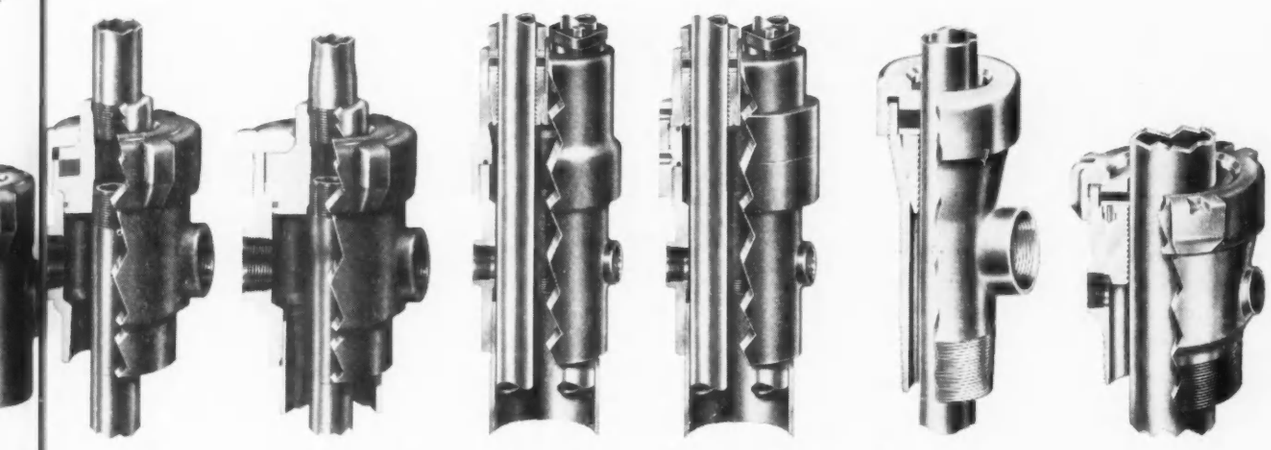

TYPE MR TYPE MOR TYPE D TYPE DS TYPE X FIG. 92

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Reference is made to the accompanying seismic section. Record 1 was shot near Tulsa, Okla. Reflections were obtained from the Fort Scott limestone at 0.04 seconds, approximately 300 feet in depth. Record 2 from Allen County, Kansas, shows reflections from the Bartlesville at approximately 0.1 seconds and from the lower Pennsylvanian between 0.2 and 0.35 seconds. The Bartlesville in this area is approximately 800 feet in depth. Record 3 from Payne County, Oklahoma, shows reflections from several horizons to a depth of around 4,000 feet.

Spread lengths from 150 to 300 feet were used for this shallow work. The dynamite charges ranged from 2 ounces to 2 pounds. Records 1 and 2 show both conventional seismograms and seismic model presentations. The seismic model is of assistance in visualizing reflection arrivals and record section presentations.

The equipment utilizes an "expander" instead of automatic gain control to maintain adequate amplitude control. The expander provides a pre-programmed rate of gain increase on the seismogram. During the early, high amplitude arrivals, the gain of the amplifier is low. This gain is increased as the seismic energy decreases. Various pre-set gains and rates of expansion are available on this equipment. The ability of this expander system to obtain very early amplitude control is shown on Record 1 where the Fort Scott arrival is very close to the first arrival surface waves.

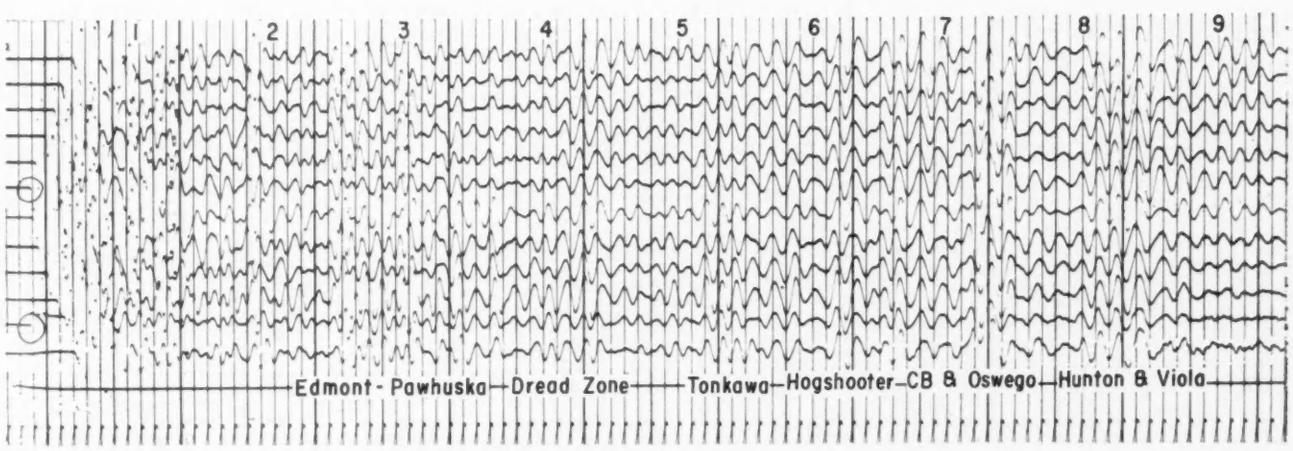
The filter pass band of the displayed records is from 55 to 110 cycles.

The weight and power requirements for a complete field assembly are listed in Table 1.

The equipment has performed satisfactorily at temperature ranges from 110° F to 0° F without noticeable change in amplitude or phase.

Table 1—Weight-power requirements, "suitcase seismic" field assembly

Number	Item	Total weight (pounds)	Amperage
one	12-channel suitcase	48	4
one	12-channel seismod	8	0.2
one	25-trace paper camera	27	4
two	cables and reels at 30 pounds	60	..
37	seismometers	35	..
one	12-volt battery	20	..
one	blaster	5	..
one	developer	13	..



This section, typical of central Oklahoma formations, was made from surveys by "suitcase seismic."

—The End

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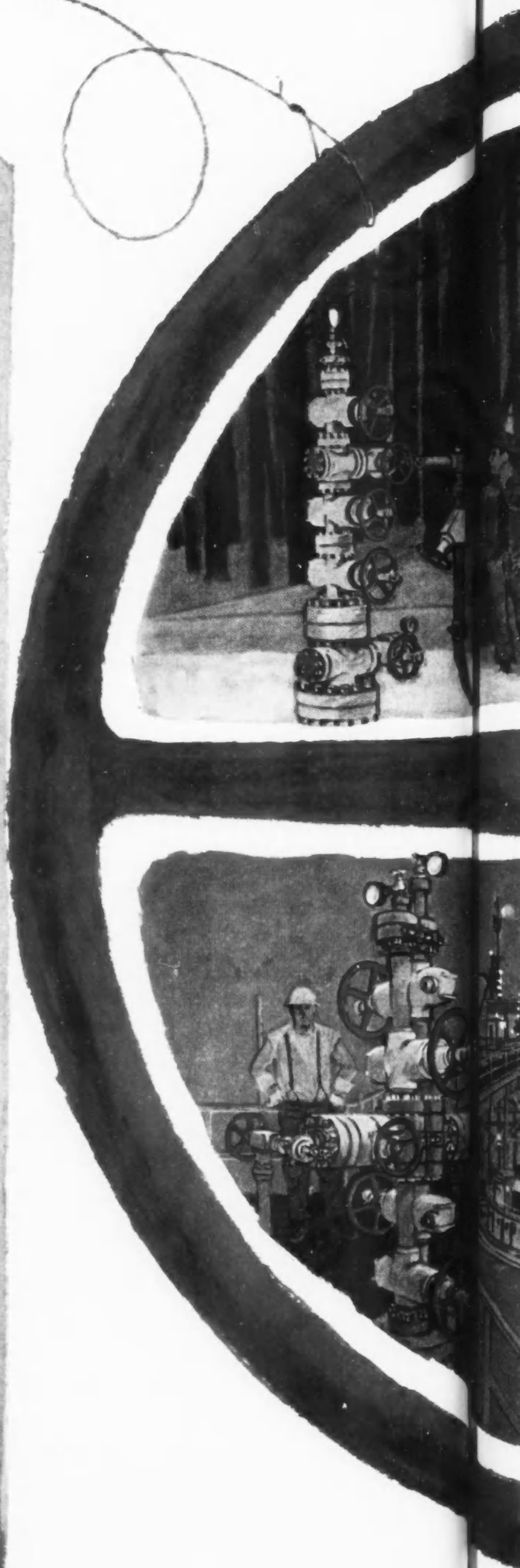

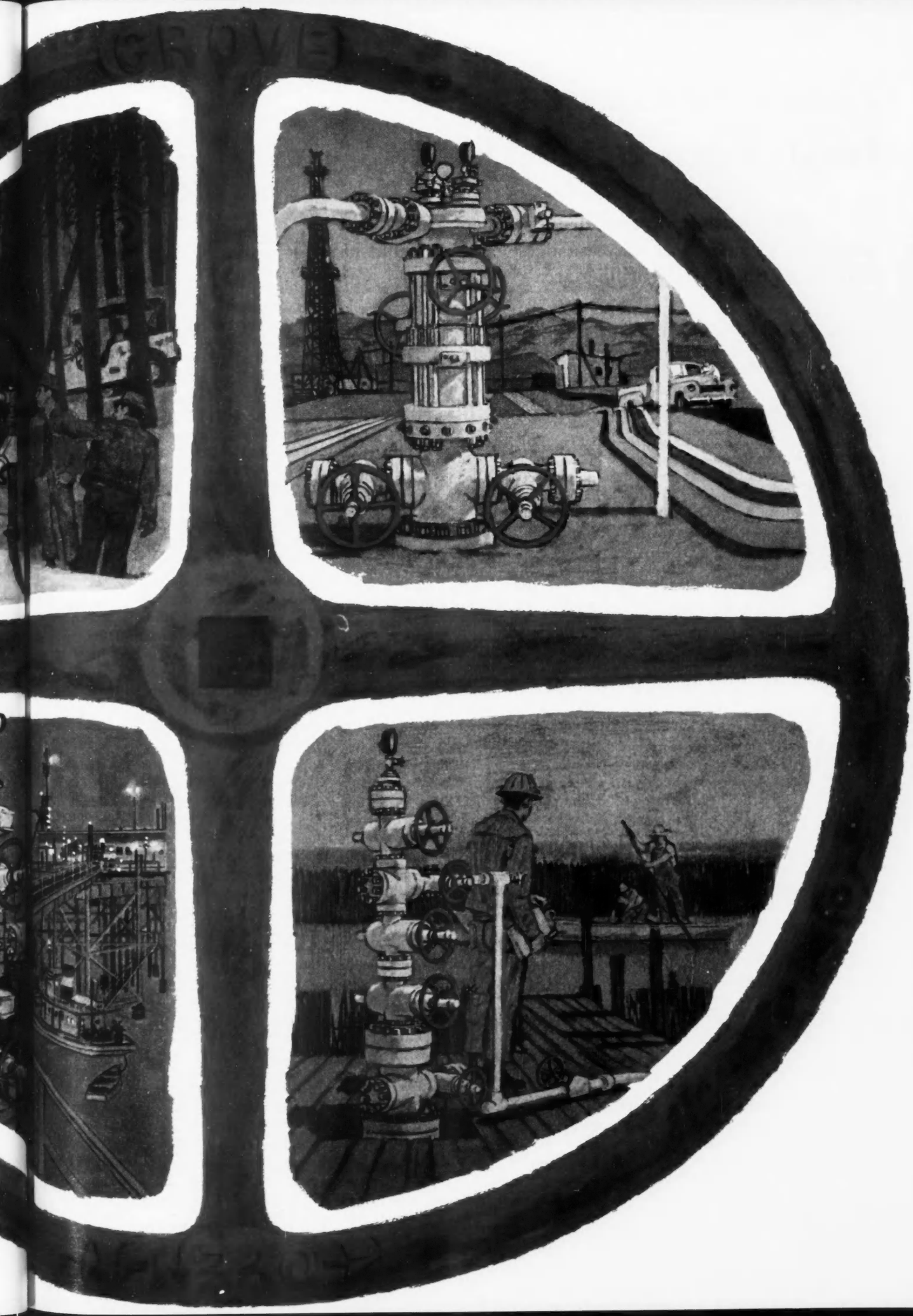

New discoveries spur Nebraska activity

Relatively cheap drilling, good lease deals, reasonable success ratios have made southwest Nebraska the Rockies' most active drilling area

THERE HAS BEEN more drilling in Nebraska this year than in any other Rocky Mountain State. Through July, Nebraska's lead over Wyoming, the region's second most active state, was substantial.

Half a dozen counties in the southwestern part of the state are responsible for the jump in Nebraska activity. This area is east of the Denver Julesburg Basin where Nebraska's first significant oil production was developed. Production is from Pennsylvanian and Cambrian reservoirs in contrast to the exclusively Cretaceous production in the Nebraska portion of the Denver Julesburg Basin.

Like the Denver Julesburg, however, the new play is characterized by relatively fast and inexpensive drilling, and was initially aided by a fairly open lease situation.

This entire east-of-the-Denver Julesburg center of activity is rather loosely referred to as the Cambridge Arch area. Principal development has been centered on the Cambridge Arch through Red Willow and Hitchcock counties. While drilling has long since spread somewhat far afield from these two counties, the play, both as to drilling and as to lease activity retains the Cambridge Arch label.

That its impact on the region has been considerable may be judged from the fact that almost one of every six wells completed in Rocky Mountain states this year has been completed within this area of Nebraska. More than 60 percent of Nebraska's 1961 drilling has been done in the Cambridge Arch area.

Independents Active. Development has largely been an independent operation, similar to the Denver Julesburg Basin play in Nebraska's Panhandle and in northeastern Colorado. While many of the operators now active in southwestern Nebraska gravitated from the Denver Julesburg Basin, much of the early work came as a result of successes to the south in Kansas and many operators from Wichita and from the general Mid-Continent area are among those active in the Cambridge Arch section.

Major field development as to the number of producing wells drilled has been done by Frontier Refining, Midwest Oil and Pubco Petroleum. Frontier discovered Ackman field in central Red Willow County. This was the first substantial development east of Hitchcock County, and was responsible for the expansion of exploration which later resulted in discoveries at Sleepy Hollow and Silver Creek fields. In the latter fields, Midwest and Pubco were most active in development.

Active operators in this area of Nebraska at the present time include Murfin Drilling, Burch Drilling, Pubco, Sauvage Drilling, Far West Trading, Simmons Oil, Strata Oil, Champlin Oil & Refining, Skelly Oil, Interstate Natural Gas, Brinkerhoff Drilling, Alpine Oil & Royalty, Bedrock Oil, Sharples Oil, Sunray Mid-Continent Oil, W. E. Wickizer, and perhaps an even longer list of individuals operating either singly or in groups.

Superior Oil, British-American Oil Producing, Pan American Petroleum and several other major firms have either been recently active or hold a substantial lease position in the area influenced by current drilling.

Exeter Drilling, Tipps Drilling and M. W. Volentine are others who have been successful in the area. Volentine, one of the early wildcatters in this area, recently disposed of his interests in 12 Red Willow County wells for a reported $3 million.

Geology. The Cambridge Arch trends northward from Kansas, and is centered roughly along the Red Willow-Furnas County line and into the northwest-southeast trend of the Chadron Arch which traverses this portion of Nebraska from origin in the Hartville Uplift area of Wyoming.

Exact definition of the Cambridge Arch structure is not readily advanced by geologists. Ackman field is believed by some to be about 10 to 12 miles west of the crest of this feature. Production is believed to be associated with the granite knobs and erosional unconformities known to be characteristic of the area. Oread and Lansing-Kansas City are definitely identified as producing formations in nearly all fields in the area.

The Sleepy Hollow discovery in northeastern Red Willow County was originally said to be productive from Cambrian. However, there is a difference of opinion as to whether the deeper producing formation is Reagan (Cambrian) as it is often identified, or whether it is a basal Pennsylvanian deposition in which eroded Cambrian sediments are mixed.

Before the discovery of Ackman field in November of 1959, western Nebraska had only four areas of Pennsylvanian production—all of them in Hitchcock and Red Willow counties. These were Jones and Rickard fields, Poore field, Barger field and the Reiher-Frakes-Burr Oak group of fields in Hitchcock County. The latter group, consolidated as Reiher field, is the only major development among those listed above, although Barger field has been considerably expanded since the Pennsylvanian play in-creased in intensity.

The Ackman discovery was Frontier Refining's Reiners 1. It was completed for a pump gage of 122 barrels of oil per day from 3,273-78 and 3,307-10 feet in Lansing-Kansas City. The formation was topped at 3,221 feet. Frontier's second well in the field pumped 264 barrels of oil per day.

For a time, the Ackman discovery excited little attention, since other discoveries in this portion of the state had not produced a substantial development program. As drilling progressed at Ackman, it became apparent that the field was to be more substantial than some of the earlier discoveries upon which original judgement was based. Ackman is now more than a mile wide, about four miles in north-south extent, has 50 completed producers. Oread (Pennsylva-

nian, above Lansing-Kansas City) has been proved productive in a portion of the field.

In July of 1960 Murfin Drilling completed Barth 1, about six miles northeast of Ackman, for 144 barrels of oil per day on pump. Production was from Cambrian from 3,418-25 foot. This was the first production in Nebraska from formations identified as Cambrian. Work didn't become intense in the field until about November when Midwest Oil, Ohio Oil and Pubco Petroleum commenced drilling. Early development also showed Lansing-Kansas City to be productive.

Activity increases. At the present time, no less than 123 wells have been completed at Silver Creek, with several others at or near completion. Neither the north nor south limits of the field have been definitely defined.

A 40-acre spacing pattern was established for this field, and development of the two reservoirs is on a twin well basis rather than by dual completion. At least 49 twin wells are listed for the field in addition to the 123 cited above.

Sleepy Hollow is now Nebraska's largest producer, with more than 8,000 barrels per day credited to wells now on production.

During development at Sleepy Hollow, discoveries were made at Silver Creek, now a 15 well field, to the southeast, at Bartley field, east of Sleepy Hollow, in the area southwest and southeast of Silver Creek, and across the line in Furnas County. The latter discovery, eight miles east of Silver Creek, is still the only producer in the county.

Barger field, in northwestern Red Willow County, one of the older discoveries east of the Denver Julesburg Basin, got new attention, and a half dozen new Pennsylvanian producers were added there. Increased drilling in Dundy County added a couple of smaller Pennsylvanian pools as interest radiated outward from the Ackman-Sleepy Hollow area. Frontier County, north of Red Willow and Hitchcock counties became active, has been added to the list of Nebraska producing counties, but development has not yet shown the caliber of the discovery in this county.

Exploration has spread rapidly throughout much of the west-central portion of the state. Blaine, Chase, Custer, Dawson, Franklin, Gosper, Greeley, Hayes, Howard, Knox, Lincoln, Phelps, Webster, Wheeler, and Harlan counties all have had activity. Leasing has been even more widespread and exploratory programs are known to be in the offing for the counties named and for others which recent drilling has not yet affected. One Lincoln County wildcat—southwest of the town of North Platte—recently logged Pennsylvanian shows of encouraging but not commercial caliber.

Drilling is relatively cheap. Underlying the rapid spread of drilling in this portion of Nebraska is the decline of Denver Julesburg Basin work, relatively cheap drilling, and a willingness to deal in leases. However, the availability of farmout and participation deals varies depending on the amount of success current at any given time. During the Sleepy Hollow development leases were relatively tight. The past few months have been without a major discovery, thus easing the lease situation somewhat.

Drilling in the area is rapid, goes only to 3,500-5,000 feet. A producer may be completed for about $40,000 and a failure can be plugged for $13-15,000. Drilling procedures are normal, with the only difficulty mentioned being occasional lost circulation in the Dakota series.

Score for some of the more active counties this year defines the Cambridge Arch play as well as anything. Red Willow County had 60 wildcats completed through July. Frontier County had 24, Furnas County 22. Red Willow County alone had 182 development completions.

Active rotary census in Nebraska rose above 40 rigs in early summer. It has slacked to some extent now, but current indications are that this is but a lull—that Nebraska's Cambridge Arch play is to proceed with good momentum through the remainder of 1961 even though discoveries may be lacking.

Recent history wouldn't indicate the likelihood of continued exploration without success. The same operators who took a long time to get excited about the Cambridge Arch apparently will take even longer to become disenchanted. There's the possibility of another Silver Creek.

—The End

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Newest offshore vessel to drill at any depths

Global Marine's CUSS II, designed for Gulf of Mexico operations, to be ready in January

UNDER CONSTRUCTION at the Equitable Equipment Company shipyard in New Orleans is the newest and largest free-floating offshore drilling vessel in the world. The craft is Global Marine Exploration Company's CUSS II, a 267-foot, 5,500-ton ship designed for Gulf operations. The craft is expected to be in operation about January 1.

Greater depth, more stability and better material and equipment handling are the major design considerations being incorporated into the vessel. In these three areas there will be noticeable improvements over the firm's CUSS I.

A feature of singular importance is that the CUSS II has been designed from keel up as a drilling vessel. This has permitted equipment layout ideas not possible on the firm's CUSS I, a former Navy barge.

The new CUSS will be fitted out and equipped to drill to depths in excess of 15,000 feet in any water depth. Modifications of the smaller CUSS I enabled that vessel to successfully handle the first phase of the Mohole Project in 12,000 feet of water off the coast of Mexico last spring.

Greater stability under normal Gulf sea conditions has been assured through extensive tank tests of CUSS II models. In these tests the 4- to 8-second wave periods normally found in the Gulf were duplicated in arriving at hull and equipment design for the CUSS II. A different type of anchoring pattern, made possible by modifying on-deck winch arrangements, will allow the CUSS II to be rotated 140 degrees while making hole, thereby permitting the vessel to carry the seas fore and aft at all times, rather than be forced to roll into the seas broadside. Special design of the stern section assures that seas can be taken on the stern as well as the bow.

Materials handling methods will be attacked partly through automation, partly through different equipment design and arrangements. In part, this is possible through the increased breadth of CUSS II. She is 58 feet across the main deck; CUSS I is 48 feet. The additional 10 feet makes possible not only an uncommonly large (36 by 58-foot) derrick floor, but a large window in the forward and after side of the 136 foot specially-designed derrick. The forward window has the increased elevation needed for handling horizontally-racked trebles of 5½-inch drill pipe.

The large opening on the afterside of the derrick will permit the starboard-mounted 20-ton revolving crane to swing its 60-foot boom through a radius that will take in a port-side deck cargo landing area and into the middle of the derrick floor. This will eliminate the high-lines and air tugs used for working drilling equipment to the derrick floor aboard CUSS I.

Drill pipe will be racked horizontally, as aboard CUSS I, and will be moved to a central trough automatically for transfer to the 500-ton traveling block. Also, as aboard CUSS I, the derrick man operates from a position adjacent to the driller, using pneumatic controls to operate the horizontal pipe racker and transfer equipment.

The 12,000 feet of casing, which can be carried on CUSS II in addition to the 15,000 feet of drill pipe, is racked amidships, just aft of the derrick floor. To port of this racking area is a ten-foot wide cargo landing area with tracks running forward to the drilling and to cargo hatches in the main deck and below the elevated drill pipe rack. Over these hatches will be air tugs and falls for transferring supplies from track-mounted dollies into below-deck storage.

Cement, mud and chemicals in bulk form will be handled pneumatically below deck. Steel storage pods will hold 4,800 sacks of dry mud, 2,500 sacks of dry cement and 2,000 barrels of liquid mud as well as fuel oil, drilling water and potable water.

Power for all operations will be electric. There will be separate motor drives for both the drawworks and rotary table, with power supplied by a battery of seven diesel-electric units below the main deck forward of the platform. Nearly 3,000 kw of power will be generated aboard CUSS II for operation of everything from the electric galley and quarters air conditioning system to the drilling machinery and ship's service machinery.

Provision has been made for installation of twin propellers aft. These, when installed, will have electric motor drive from power generated from the main drilling power package. Dynamic positioning will be possible by installing a transverse propeller in the bow section and possibly a vertical axis positioning propeller in the stern. These, too, will be electrically driven. Global officials point out, however, that there is no plan to install dynamic positioning equipment at this time.

The hull of CUSS II is of all-welded steel construction and will draw 15 feet when loaded. The personnel quarters for 46 can be quickly expanded for more than 60 should conditions so demand.

The addition of CUSS II to its fleet will provide Global Marine with a four-vessel fleet of free-floating drilling craft. In addition, to the 260-foot, 3,000 ton CUSS I, Global also operates the 174-foot, 300 ton M. V. SUBMAREX and the 204-foot, 1,300 ton SM-1. The CUSS I and SM-1 are currently operating off the California coast and, along with the M. V. SUBMAREX, have accumulated a total of nearly 500,000 feet of hole in ocean depths up to 12,000 feet.

CUSS II Data

Displacement	5,500 tons
Length	267 feet
Breadth	58 feet
Draft	15 feet
Drill pipe	15,000 feet of 5½"
Casing	12,000 feet of 9⅝"
Hook capacity	500 tons
Derrick height	136 feet
Personnel	46

—The End

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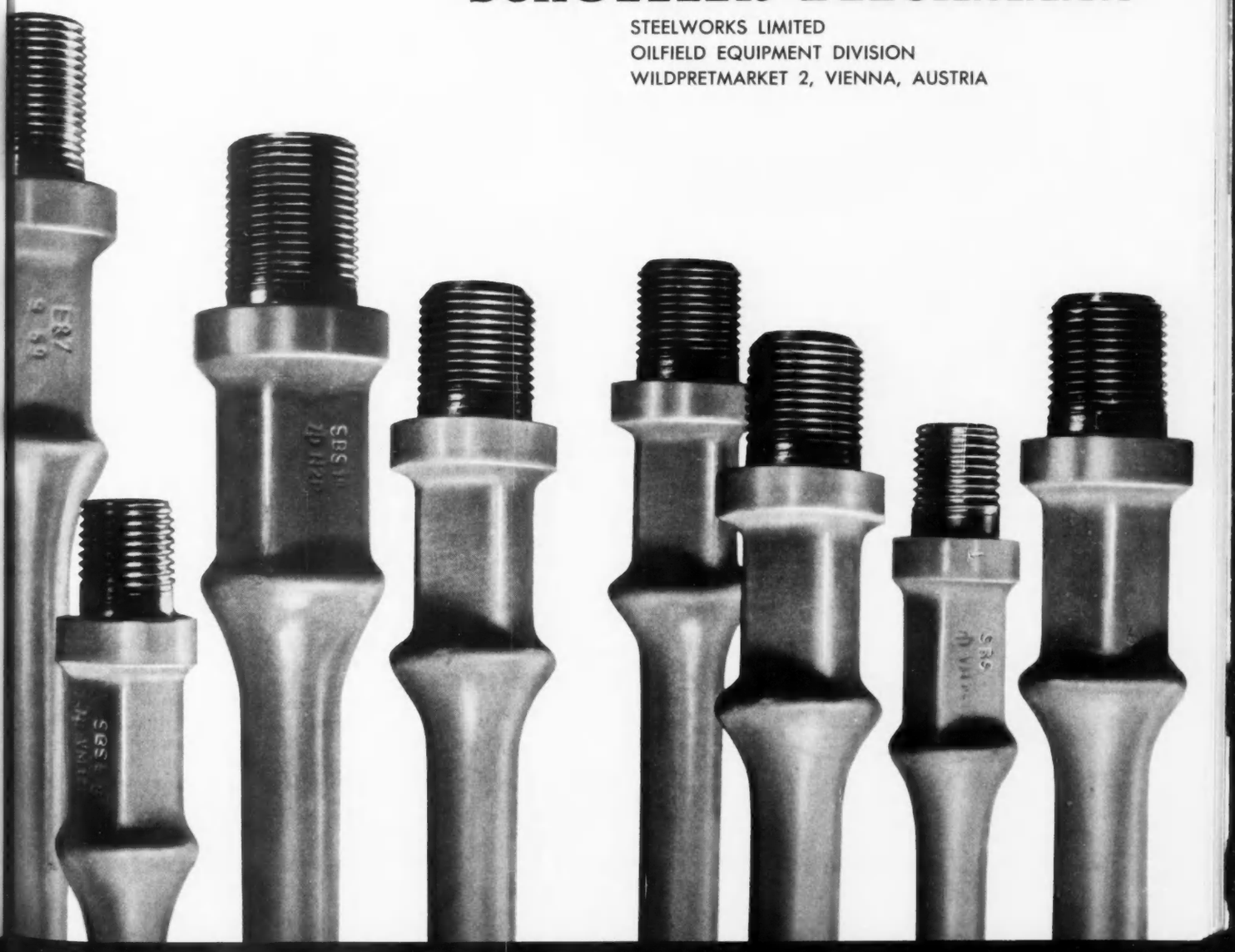

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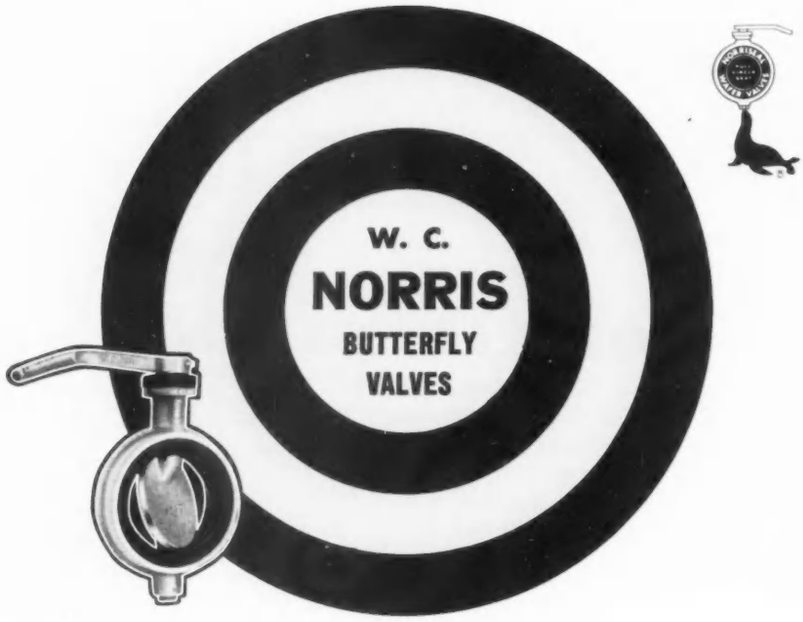
ENERGY AND MAN, A SYMPOSIUM, Appleton-Century-Crofts, Inc., New York, Allan Nevins, Robert C. Dunlop, Edward Teller, Edward S. Mason and Herbert Hoover, Jr., $3.75.

In this volume, five distinguished authorities on the production, use and importance of energy in civilization have collaborated to produce a symposium of significance. These papers, entitled *Energy in the History of Western Man, The Petroleum Revolution, Energy Patterns of the Future, Low Cost and Abundant Energy,* and *Energy and Public Affairs,* were originally presented as address at a gathering of over 300 government officials, business executives, scientists, historians and economists, who met at Columbia University on November 4, 1959, for a symposium co-sponsored by Columbia's Graduate School of Business and the American Petroleum Institute as a part of its centennial activities.



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PRINCIPALS OF PETROLEUM GEOLOGY, McGraw-Hill Book Company, 330 West 42 Street, New York, William L. Russell, Professor of Geology, Agricultural and Mechanical College of Texas, $9.50.

This comprehensive survey of petroleum geology discusses important principles, processes and techniques, covering every aspect of the subject, from the origin and accumulation of oil to the future prospects of petroleum geology.

The concept of traps for oil and gas is described and illustrated, and the discussion of well logging and geophysics is brief but thoroughly up to date. Also includes geologic maps, charts, and diagrams to simplify understanding and to add to practical value of the book.

PETROLEUM ENGINEERING DRILLING AND WELL COMPLETIONS, Prentice-Hall, Inc., Englewood Cliffs, N. J., Carl Gatlin, Department of Petroleum Engineering, The University of Texas.

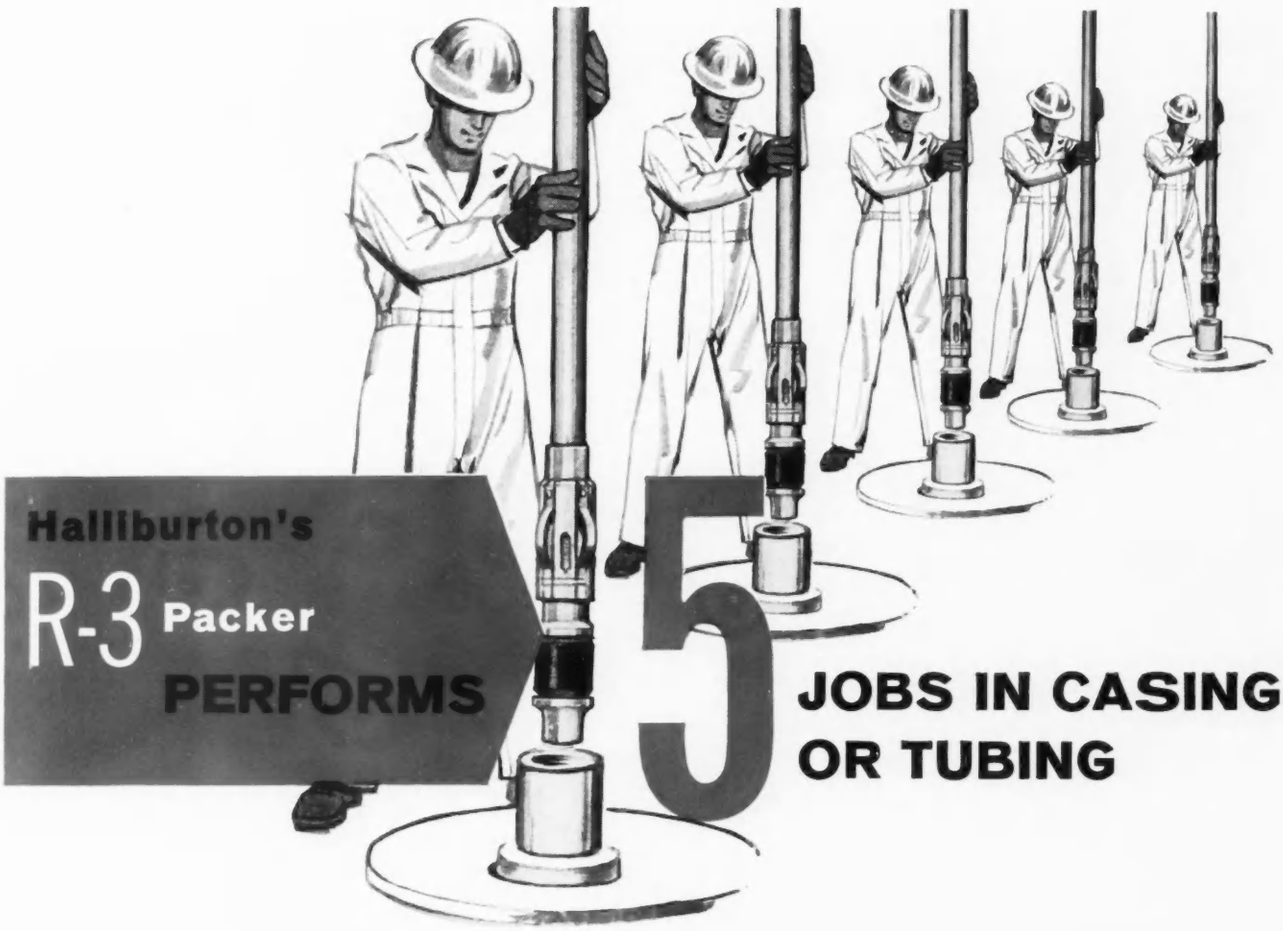
In this study, the author stresses the start-to-finish problems of drilling and completing oil wells. He examines the basic elements of drilling, testing, formations, evaluation and completions, also surveys various geological and geophysical exploration methods.

Examples and problems are worked into the text and many solutions are included to help you gage your reading. Illustrations combined with streamlined, uncluttered text material add to a clear, readable coverage of well location and development. Gatlin provides a background for development of advanced mathematical projection by introducing basic reservoir engineering concepts in connection with fluid and rock properties, logging, drill stem testing, core analysis and pressure build-up analysis.

ELEMENTARY MATHEMATICS OF LINEAR PROGRAMING AND GAME THEORY, Bureau of Business and Economic Research College of Business and Public Service, Michigan State University, East Lansing, Mich., Edward G. Bennion, General Economics Department, Standard Oil Company (New Jersey), $5.

This book is for the reader who wishes to learn the rationale underlying linear programing and game theory. It has been designed to meet the needs of the mathematically unsophisticated reader limiting the scope of his discussion to fundamental concepts. The result is a pedagogical contribution to a growing field of study which is of interest to both readers and business practitioners.

RELIEF MAP OF AFRICA. Multicolored plastic wall map with vertical scale exaggerated 30 times to stress relief, drainage, and other topographic features, is 46 inches tall and 41 inches wide along interior margins. Political subdivisions up to date. Approximate offshore water depths indicated by blue shading. Aero Service Corp., Philadelphia, Pa.



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Short and compact, the Halliburton R-3 retrievable Packer is designed to withstand up to 5,000 psi working pressure differential for use in treating, fracturing, testing, water flooding, and producing wells. It is available for use in casing sizes ranging from 2⅞" O.D. through 7" O.D.

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Used as a tension packer – the Halliburton R-3 Treating Packer requires no hold-down when resisting pressures from below. The packer is set simply by running it to the desired depth, making a ¼ turn to the right and picking up on the tubing. This sets the slips and expands the 75 durometer packer rubber inside the casing. To unseat quickly, lower the tubing to release the packer and automatically lock it in a retracted position.

Used as a conventional hook wall packer – the inverted Halliburton R-3 Treating Packer is designed to hold pressures from above or below. When using the packer this way, the tubing is attached to the lower end of the mandrel assembly and run to the desired depth. The usual tension operating procedure is reversed to seat or unseat the packer. Using a Halliburton Hydraulic Tubing Hold-Down – either round slip type or the larger rectangular slips for higher pressures from below the packer – helps prevent upward movement of packer.

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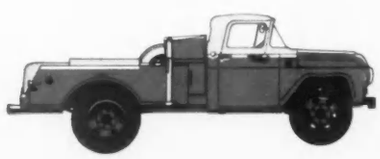

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Men in the industry

John W. Phenicie has been named assistant division production superintendent for **Pan American Petroleum Corporation** in Houston. He replaces **J. C. McCarthy** who has been moved to Pan American's Rocky Mountain Division office in Casper, Wyo.

Durland E. Clark is the new assistant to the vice president of the Pacific Coast exploration and production area of **Shell Oil Company.** Clark succeeds **P. A. Dennie** who becomes Shell's production manager in the Denver area.

D. E. Clark

R. E. McCarley

Robert E. McCarley has joined **M. J. Delaney Co.** as production and drilling engineer. He is a former senior drilling engineer in the Mid-Continent area for The Atlantic Refining Co.

J. Duncan Goodrich has been appointed director of production research in the exploration and production research division of **Shell Development Company** in Houston. He replaces **B. P. Eastin,** recently named vice president-production for Shell in New York.

S. I. Betzer has been named superintendent of the Panhandle district for **Phillips Petroleum Company** with headquarters in Borger, Texas. Other Phillips changes: **R. W. O'Neill,** district superintendent of the North Burbank Unit, Shidler, Okla., and **J. L. Bowden** district foreman of the North Burbank Unit.

Dr. Lawreace Y. Faust, geophysical supervisor for **Amerada Petroleum Corp.,** Tulsa, has been elected president of the Society of Exploration Geophysicists. **Dr. Milton B. Dobrin,** chief geophysicist for **United Geophysical Corp.,** Pasadena, Calif., was elected first vice president. **Dr. Stanley H. Ward,** consulting geophysicist and associate professor of mineral exploration at the **University of California** will be vice-president. **R. Maxey Pinson,** division geophysicist for **Union Oil Company of California,** Midland, Texas, was elected secretary-treasurer, and **R. B. Rice,** supervisor of the physics department of **The Ohio Oil Company,** was elected editor. The new officers will take over at the society's 31st annual international meeting November 5-9 in Denver.

Roy O. Smith has opened a geophysical consulting office in Houston. He was formerly with Robert H. Ray Company, Southern Geophysical Company and States Exploration Company.

L. Lynn Elliott has joined **Tower Oil & Gas Company** of Texas, Dallas, as vice president and general counsel.

Floyd E. Suder, Jr., is now a reservoir engineer in the **Forest Oil Corporation** Houston office.

W. A. Black has been promoted to general production superintendent for **Helmerich & Payne, Inc.,** Tulsa.

Dr. R. Manus Foster has been named senior research associate at **Socony Mobil Oil Company** field research lab in Dallas.

Dr. M. King Hubbert, consultant in general geology for **Shell Development Company,** has been named visiting professor of geology and geophysics of Stanford University for 1961-1963.

Gulf Oil Corporation has announced six personnel changes in its domestic production staff.

W. H. LeGrand, formerly area production manager of the Pierce Junction Area, has been transferred to Gulf Oil's Delta Area in Louisiana.

J. L. Herndon, district exploration manager in the Jackson (Miss.) District, has been named district landman for the New Orleans District.

H. F. Swannack, now area drilling foreman in the Odessa Area, has been promoted to area production manager at Pierce Junction.

F. B. Inks, area drilling engineer for the Delta Area, has been promoted to area drilling foreman in the Odessa (Tex.) Area.

T. A. Trax, area production manager for the Salt Lake City Area, has been transferred to the Wichita Falls Area in the same capacity.

T. W. Kidd, district engineer in the Midland District, will be promoted and transferred to the Odessa Area as area production manager.

Hein I. Koolsbergen, who has been coordinator of oil operations for Newmont Mining Corporation, has been elected as the new president of **The Oil Shale Corporation.** He succeeds **H. E. Linden,** founder, who has been elected chairman of the executive committee. **Nathan W. Levin,** investment manager, has been elected vice chairman of the board of directors.

Koolsbergen

George T. Goggin, executive vice president of **Douglas Oil Company of California,** Los Angeles, has been appointed to the National Petroleum Council by Interior Secretary **Stewart L. Udall.**

J. E. Roth, Tidewater Oil Co. senior vice president, has been given additional executive assignments, according to **George F. Getty II,** president.

In other changes, **Charles R. Brown,** vice president and general manager of the Western Division, joins Tidewater's executive management group as vice president for exploration and production. **James McDonald,** assistant Western Division manager, has been named a vice president and succeeds Brown.

Capt. Ed. R. Vorenkamp has been named a vice president of the **Consmar Corp.,** marine consultings in New Orleans, La.

Bert Sager has rejoined the staff of **Brinkerhoff Drilling Co.** in Denver after an eight-year absence.

John T. Poynor has opened a petroleum consulting service in Liberty, Texas.

Atholl McBean has resigned from the board of directors of **Standard Oil Company of California.** He had been a member of the board 19 years.

Earle Marshall, a vice president of Empire Trust Co., New York, is a new member of the board of directors of **White Eagle International, Inc.** of Midland, Texas.

R. I. Dickey has been appointed vice president of exploration for **Texas Pacific Coal and Oil Company of Fort Worth. Edd Riddle, Jr.,** Midland (Texas) division exploration manager, moves to Fort Worth headquarters to become exploration coordinator. William Parsons succeeds Riddle in Midland.

Alfredo Federico Bracht, Argentine business executive and financier, has been elected president of **Petroquimica Argentina, S. A. Dr. Wesley S. Coe** is new managing director of PASA.

J. B. Turner, Jr., has been named head of the Engineering Section in Humble's Houston office. He has been serving as engineering advisor in the General Services Department of the Humble Division.

Edward A. Gribi, Jr., has returned to full-time consulting geological practice in King City, Calif.

J. Roy Goodearle and **Leon Manry, Jr.,** have formed **Petroleum Engineers & Geologists** with headquarters in Houston. .

Thomas D. Durrance succeeds **H. O. Thompson** as vice president-public relations for **Arabian American Oil Company.** Thompson will continue to serve the company in a consulting capacity. Durrance continues to make headquarters in the Middle East.

Donald W. Buchanan has been promoted to assistant production manager of **Continental Oil Company's** Central Region. Formerly superintendent of

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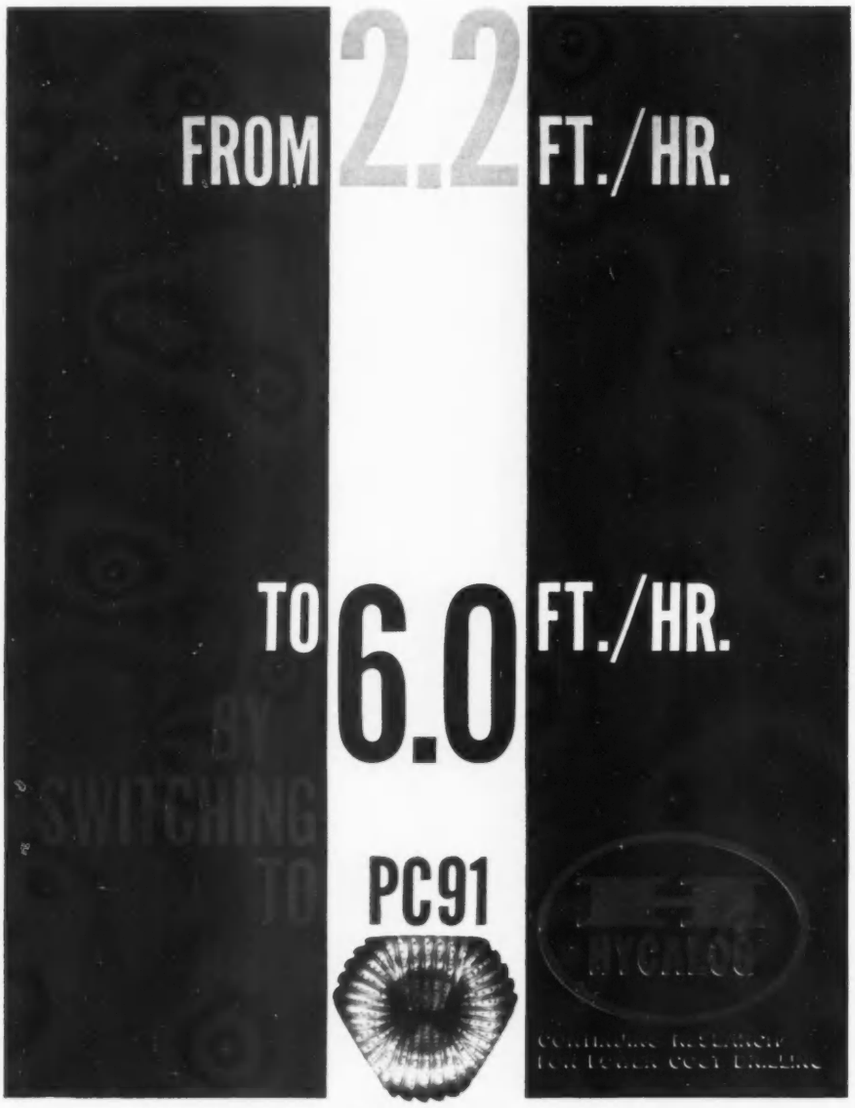

PERFORMANCE DATA

TYPE	FT. DRILLED	HOURS RUN	FT./HR.
MAKE A, ROCK BIT	3	2	1.5
MAKE B, ROCK BIT	11	5	2.2
HYCALOG, DIAMOND PC 91	**1440**	**240**	**6.0**

AT 12,000′-13,000′ DEPTHS in South Louisiana where this run was made, the saving in trip time alone amounted to thousands of dollars. And the diamond bit cost no more than the dozens of conventional bits which would have been required to do the same job.

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Men in the industry

Conoco's Illinois Basin District. Buchanan will make his new headquarters in Oklahoma City.

Robert F. Vickers has been appointed to the position of secretary of **The Vickers Petroleum Company, Inc.,** succeeding the retired **M. C. Lyons.** Also, **V. J. Lumm** has been named assistant secretary and placed in charge of a newly formed department. **George Harris** has been promoted to the position of assistant controller.

Dr. Stephen L. Wythe has been named an assistant director of the Products Research Division at **Esso Research and Engineering Company. John O. Collins** has been named a research associate in the same division.

P. L. Vanlue has been re-appointed to the position of financial assistant to **G. F. Bish,** vice president of domestic production of **The Ohio Oil Company.**

E. L. Steiniger

P. C. Spencer

Edward L. Steiniger, president, **Sinclair Oil Corporation,** has been designated by the board of directors as chief executive officer of the company. Steiniger succeeds **P. C. Spencer,** who continues as chairman of the board. The executive committee of Sinclair is now composed of **Spencer, Steiniger, J. E. Dyer, H. Jefferies, O. P. Thomas, T. B. Kimball** and **George J. Leness.**

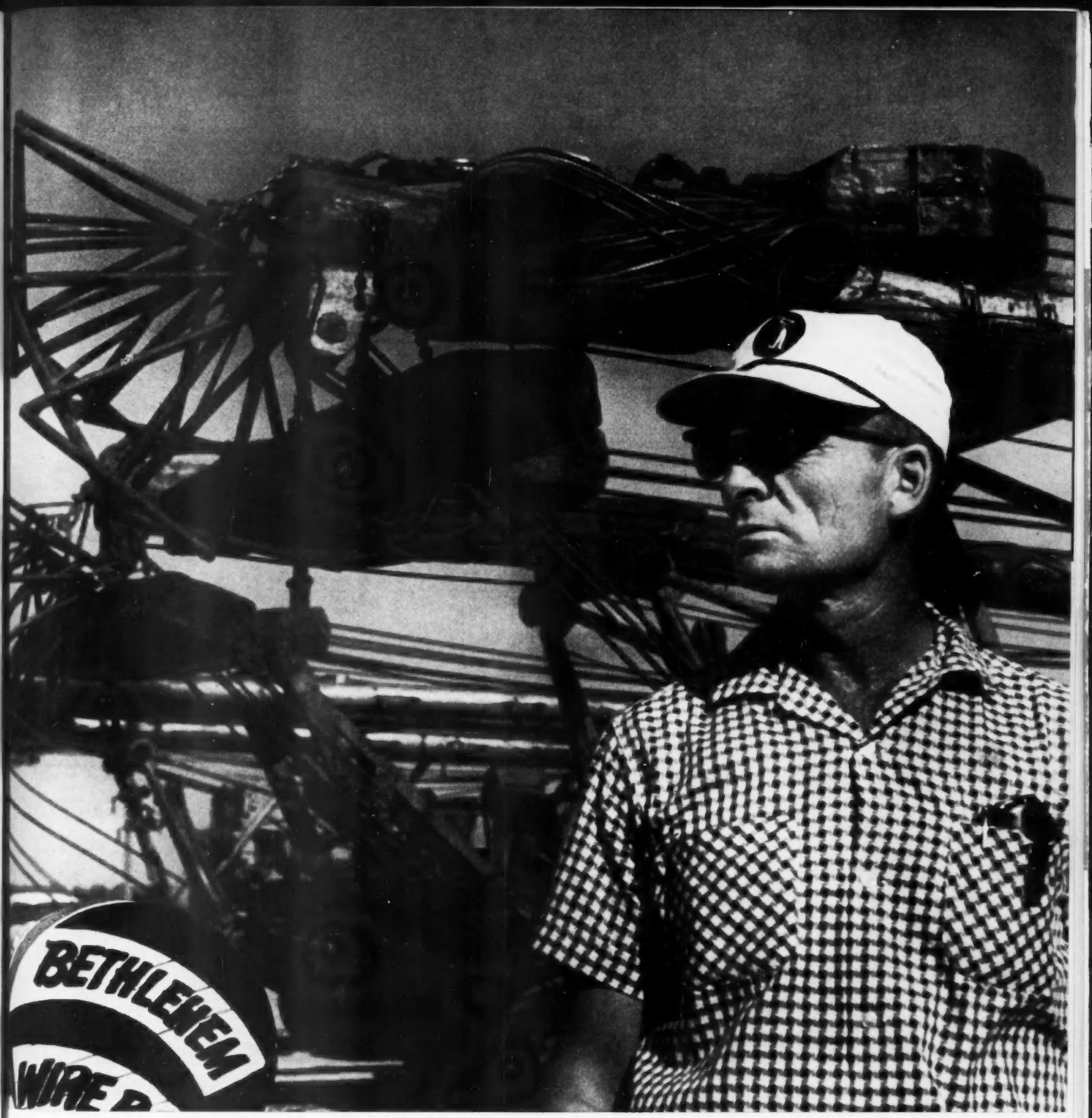
William Lohff has been appointed a patent attorney in the Patents and Licensing Department of the **American Oil Company.**

John C. Carnahan, treasurer, **Schermerhorn Oil Corporation,** has been elected to membership in the Controllers Institute of America.

Ford M. Graham has been elected president of **The Louisiana Land Exploration Company** and **John G. Phillips** was elected vice president. **E. J. Langhetee, Jr.,** chief petroleum engineer, was named assistant to the president.

Haynes L. Strider, area engineer for **Gulf Oil Corporation's** Production Department staff in Casper, Wyo., has been named superintendent of drilling for **Bolivian Gulf Oil Company,** a Gulf affiliate.

Walter D. Floersheimer has been elected a director of **Canadian Homestead Oils Limited.** He is a partner of the New



"It's Dependable," says West Texas Contractor using Bethlehem Wire Rope. These servicing units are in the yard of Hoffman Oil Well Service Company, Seminole, Texas. D. G. "Pappy" Hoffman, shown in the picture, specifies a considerable amount of Bethlehem Wire Rope on much of his servicing equipment. For example, each of the units shown contains more than two miles of Bethlehem 6 x 7 solid-plastic core line, and about 500 ft of Bethlehem 18 x 7 non-rotating rope. "We get good performance from Bethlehem rope," said Mr. Hoffman. "It's dependable, and we can't ask for more than that."

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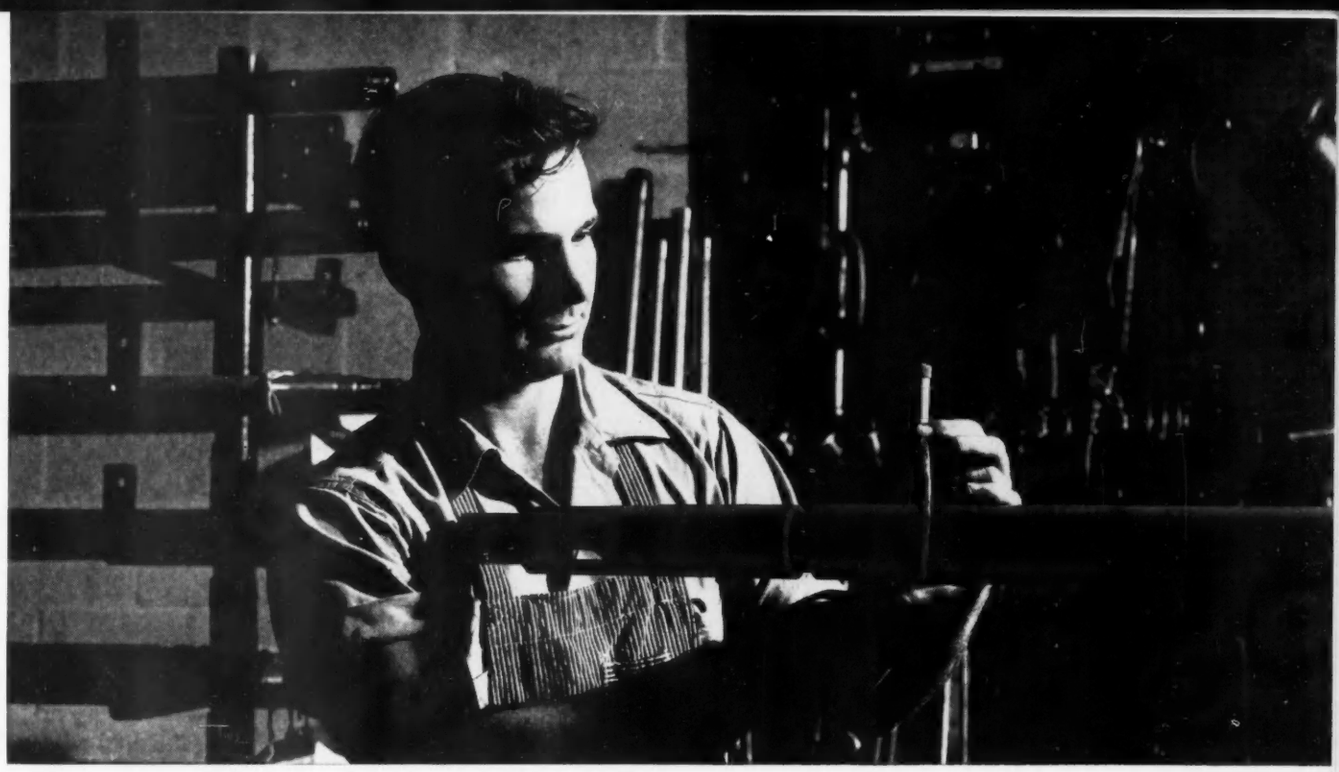

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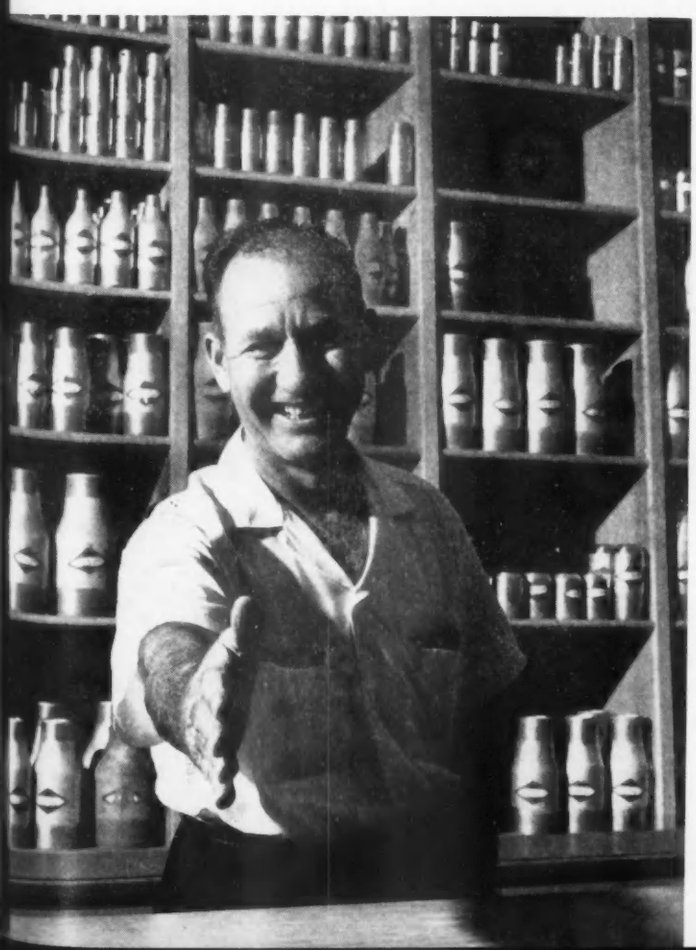

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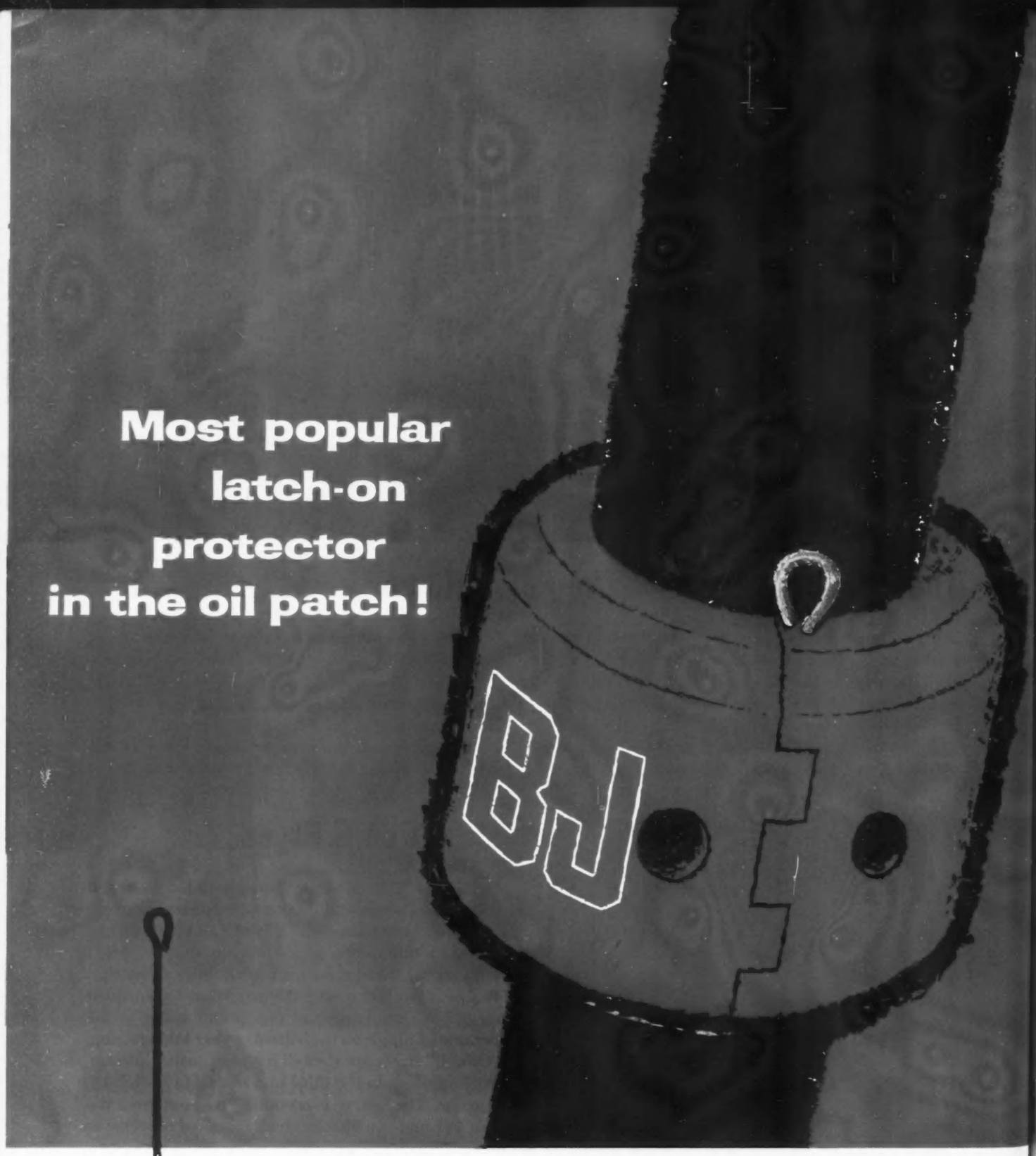

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Men in the industry

York Stock Exchange firm of Sutro Bros. & Company and a director of Crescent Petroleum Corporation. He replaces board chairman **Charles L. Follansbee** who continues as assistant secretary.

Kenneth Heady has been promoted to an assistant general attorney's position by **Phillips Petroleum Company.**

John S. Boldrick, formerly operations superintendent of **Humble Oil & Refining Company's** Midland, Texas, area, has been named production manager and will report to **John S. Bell,** area manager. Other appointments include: **Charles S. Yust,** formerly operations superintendent for the North Texas area office, Wichita Falls, named area operations superintendent and will report to Boldrick. **Haylett O'Neill, John M. Craddock** and **C. S. Overmiller** have been named to positions on Humble's Houston headquarters staff. **R. W. Bybee** of Midland, Texas, has been appointed planning and evaluation coordinator in the Exploration Department of the company's Houston headquarters office.

James A. Goolsbee and **Dixon H. Cain** have recently organized an engineering consulting firm with offices in the Niels Esperson Building, Houston. Operations will be in the field of process design, estimating, economic and feasibility studies for the production, refining, natural gas and petrochemical industries.

Donald Lynn Hall has been elected by **H. J. Gruy and Associates, Inc.,** to the position of vice president in charge of geology and exploration. Hall also was made a director of the company.

David A. McCauley has been appointed senior research associate in the research and Development Department of **American Oil Company** at Whiting, Ind.

Milo M. Brisco has been elected president of **International Petroleum Company, Ltd.** Brisco succeeds **J. K. Jamieson** who resigned.

Chas. R. Rider has been elected chairman of the board and **Guy R. Brainard, Jr.,** has been elected president of **Drilling and Exploration Company, Inc.**

Edward S. Ferris has been appointed general manager of **Arvida Oil Co.,** a subsidiary of **Arvida Corporation.**

Peter P. Weidenbruch, Jr., has joined the staff of the office of general counsel of **Socony Mobil Oil Company, Inc.,** as a tax lawyer.

Kenneth A. Wallace has joined **Canadian Homestead Oils Limited** as a staff geologist in Calgary, Alta. Wallace previously, for eight years, on the geological staff of Mobil Oil of Canada, Ltd.

Leonard M. Berger has been elected president of **Sinclair Caribbean Oil Company,** a subsidiary of **Sinclair Oil Corporation.** Berger formerly was president of **Sinclair Cuba Oil Company, S.A.**

Robert D. Bowser has joined **D. R. McCord and Associates, Inc.,** Dallas petroleum consultants, as senior process engineer. He will headquarter in Dallas.

Jack W. Hudson has been elected vice president and general manager of **British Petroleums Limited,** Calgary, Alta. Hudson succeeds the retired **Claude E. Peavy.** Also, **Nate Goodman** was appointed production superintendent. Other officers of the company include: **Robert L. Reed,** president; **Clyde N. Stone,** vice president i/c Land Department; **A. Bruce Robertson,** secretary, and **Ronald W. Hamilton,** treasurer and assistant secretary. Directors recently elected were: **Paul A. Conley, Ross H. Faulkner, Frank W. Lake, Robert L. Reed, L. E. Riffe, A. Bruce Robertson, Harry F. Smith, W. Joseph Straus** and **James G. Tremaine.**

Col. F. T. Davies has been elevated to senior vice president of **Gulf European Company.** He previously was vice president. Gulf European is a subsidiary of the **Gulf Oil Corporation.**

Robert W. Hines is the new executive vice president of **Texas Pacific Coal and Oil Company** in Forth Worth, Texas.

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LIBERAL, KAN.—Rainbo Serv. Co.....MA 4-3598
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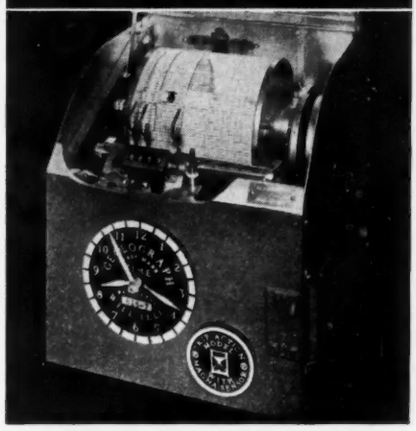

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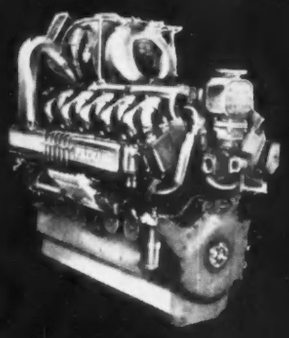

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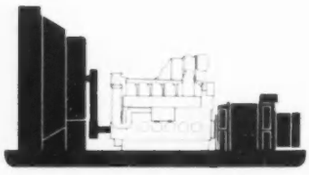
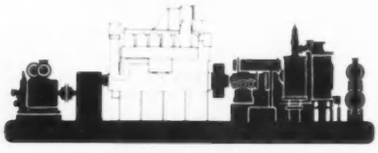
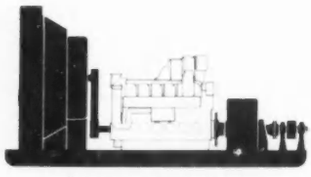


Mechanical drive with torque converter and fluid coupling.



Compressed air drilling.



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PO.10

Men in the industry

Herbert C. Smith has opened his offices as consulting geophysicist and geologist in Houston. Smith formerly was seismic supervisor with Seismic Explorations, Inc., in Houston, and more recently vice president and geophysicist of the Reynolds-Southwestern Corporation of Houston.

H. Wilkinson is a new member of the Board of Directors of **Shell Oil Company.** He is managing director of the Royal Dutch Shell Group of Companies and of the Shell Transport and Trading Co., Ltd. He replaces **F. J. Stephens,** who has resigned to become chairman of the board of Shell Transport.

H. Wilkinson

L. W. Meyers

LeMoyne W. Meyers has been named technical director and elected vice president of **D. R. McCord and Associates, Inc.,** petroleum consultants in Dallas.

George T. Piercy has been named executive assistant to **M. J. Rathbone,** president of **Standard Oil Company (New Jersey).**

R. F. Cox is the new vice president in charge of production for Southwest Gas Producing Co., Inc., **Al E. Beasley** was named vice president in charge of exploration for the Monroe, La.-based firm.

Otis B. Hocker, formerly Denver Division manager, has been named assistant to Texaco Inc. Vice President **A. W. Baucum. Roy Whisenhunt,** assistant division manager at Midland, Texas, will replace Hocker in Denver.

Other appointments announced by VP Baucum in the Domestic Producing Department include:

Kenneth E. Myron, from New York staff geologist to assistant to the Los Angeles Division manager;

Byron L. Francis, from New York staff petroleum engineer to assistant division manager at Midland, Texas; and

Laurie W. Folmar, from division petroleum engineer in the Tulsa Division to New York as staff petroleum engineer, succeeding Francis.

Donald E. Hyer of Houston has been promoted to the post of staff geologist in the New York office.

Ed Overholser of Austin, Texas, has been named assistant executive secretary of the Interstate Oil Compact Commission. His headquarters will be in Oklahoma City.

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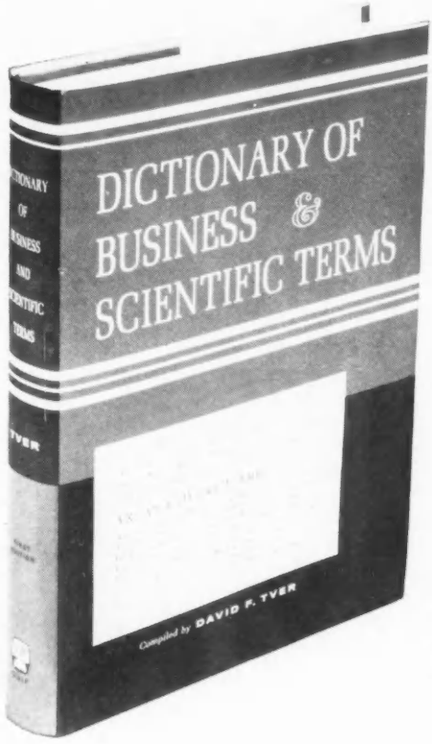

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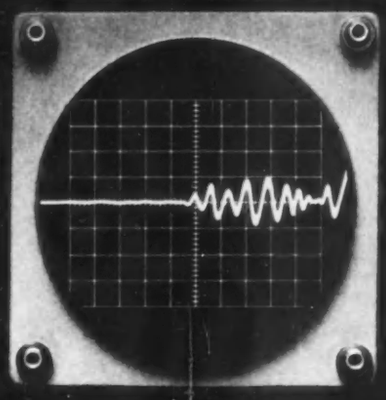
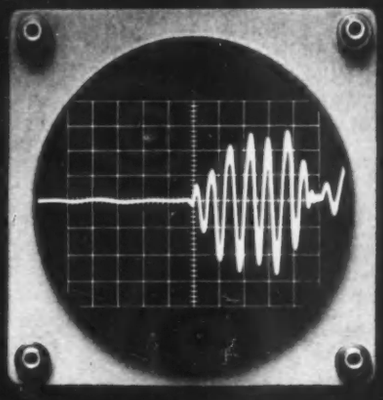
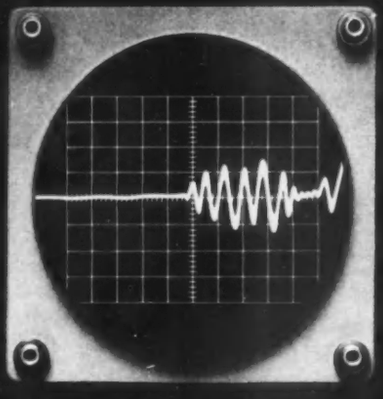


INTERVAL A — Heavily-fractured formation results in very low formation signal amplitude.



INTERVAL B — Unfractured formation results in normal signal amplitude.



INTERVAL C — Partially - fractured formation results in lower-than-normal formation signal amplitude.

WELEX FIRST AGAIN!

New Frac Finder locates best completion interval

The three intervals at left show different degrees of natural fracturing in the same limestone structure. Is there any question which interval you would select for completion?

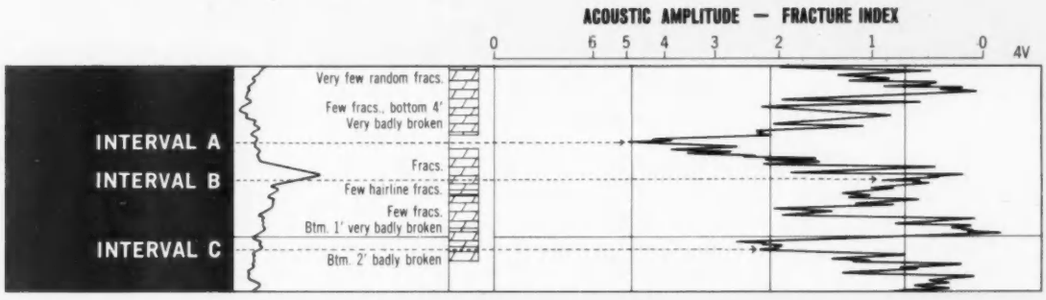
The heavily-fractured interval promises to be a star performer even though the matrix porosity and permeability may be low. But the non-fractured interval, though it's on structure, may not even make a well. This means that an accurate method is essential for determining if the fractures are open. So the only question is—**How do you find the most heavily fractured interval?**

The Welex Fracture Finder, with a direct-reading Fracture Index printed right on the log, does it simply with a single curve. The Fracture Finder (or Acoustic Amplitude Log) directly measures the formation signal amplitude, accurately locating all open natural fractures within perforating range of the well bore.

The Fracture Index is based on engineering data obtained by Welex in a full-size test pit containing natural limestone blocks. It gives an easily read quantitative measure of the degree of fracturing in each zone.

In the past, cycle skipping on acoustic velocity logs sometimes has been used in an attempt to find fractures. The Welex Fracture Finder, with its Fracture Index, makes this "trial and error" method of fracture location obsolete.

The Fracture Finder shows both vertical and horizontal fractures and gives you a complete picture on the first trip



—showing plainly where the fractures are and **the degree of fracturing.**

In fractured formations the Fracture Finder measures the reduction in the amplitude of the acoustic signal caused by reflections of energy at any interface where there is a large density change. At such interfaces a portion of the signal is reflected and a lesser amount reaches the receiver than if the fractures were not present.

On your next well, call Welex. The Welex Fracture Finder Acoustic Amplitude Log is fully tested, field proved and ready to work for you.

COMPLETE WIRELINE Welex SERVICES

WELEX

A Division of Halliburton Company

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the new
FIRST CITY NATIONAL BANK *of houston*

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

WHO'S MEETING WHERE

Sept. 7– 8	Rocky Mountain Association of Geologists Field Conference, Denver.
7– 9	Alberta Society of Petroleum Geologists and Geological Association of Canada Convention, Calgary, Alta.
13–15	Louisiana-Arkansas Division of Mid-Continent Oil & Gas Association Thirty-ninth Annual Membership Meeting, Roosevelt Hotel, New Orleans.
13–15	National Petroleum Association, Annual Meeting, Traymore Hotel, Atlantic City, N.J.
17–20	AIEE Annual Electrical Conference on the Petroleum Industry, Jung Hotel, New Orleans.
20–	API Executive Committee of the Board of Directors, Greenbrier Hotel, White Sulphur Springs, W. Va.
24–26	Empire State Petroleum Association Fall Meeting, Sagamore, Lake George, N.Y.
24–27	ASME, Petroleum Mechanical Engineering Conference, Hotel Muehlbach, Kansas City, Mo.
25–27	Texas Mid-Continent Oil & Gas Association Forty-second Annual Meeting, Texas Hotel, Fort Worth.
27–29	Corrosion Short Course, Sponsored by Central Oklahoma Section of NACE and University of Oklahoma, University of Oklahoma, Norman.
Oct. 4– 6	AAODC Twenty-First Annual Meeting, Rice Hotel, Houston.
4– 6	ASME, Process Industries Conference, Shamrock-Hilton Hotel, Houston.
4– 6	NACE Western Regional Conference Benson Hotel, Portland, Ore.
8–11	SPE of AIME Thirty-sixth Annual Fall Meeting, Memorial Auditorium, Dallas.
9–11	NACE North Central Regional Conference, Chase Park Plaza Hotel, St. Louis, Mo.
15–17	National Association of Oil Equipment Jobbers Eleventh Annual Convention and Trade Show, Mayflower Hotel, Washington, D.C.
18–20	Sixteenth Annual Convention of the Rocky Mountain Oil & Gas Association
18–21	AAPG, Mid-Continent Regional Semi-Annual Meeting, Amarillo, Texas.
18–21	AAPG Pacific Section Regional Meeting, Los Angeles.
23–26	The Metallurgical Society of AIME Fall Meeting, Pick Fort Shelby Hotel, Detroit.
23–27	ASM Metal Show, Cobo Hall, Detroit.
24–27	NACE South Central Region Conference and Exhibition, Shamrock-Hilton Hotel, Houston.
25–27	Association of Geological Societies, Gulf Coast Section Annual Meeting, San Antonio, Texas.
29–31	Independent Petroleum Association of America, Annual Meeting, Shamrock-Hilton Hotel, Houston.
Nov. 1– 3	AAPG, Southwestern Federation of Geological Societies, 4th Annual Meeting, El Paso.
2– 3	SPE of AIME, 32nd Annual California Regional Meeting Hacienda Motel, Bakersfield,
2– 4	Geological Society of America Annual Meeting, Cincinnati.
5– 9	SEG Annual Meeting, Denver.
13–15	API 41st Annual Meeting, Conrad Hilton Hotel, Chicago.
15–	API Board of Directors, Conrad Hilton Hotel, Chicago.
26– thru Dec. 1	ASME Winter Annual Meeting, Statler-Hilton Hotel, New York.
27– Dec. 1	NACE Southeast Region Conference, Key Biscayne Hotel, Miami.

Nomad's Chapter monthly meeting: Los Angeles, second Wednesday, Biltmore Hotel, Wallace A. Sawdon, Secretary. Houston, second Monday, Kaphan's, Elbert T. Walker, Secretary. Dallas-Ft. Worth, first Monday, Greater Dallas Club, Hank Davis, Secretary. Tulsa, Hotel Tulsa, Gilbert Swift, Secretary. New York, first Monday, Hotel Biltmore, Jesse E. Hickman, Secretary.

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RUN LONGER
with minimum down time!

CALL THOMPSON PUMP CO. SALES and SERVICE Stores for "full-line" service on Thompson rod pumps. Thompson oil well pumps are made to run longer with expert Thompson care. Our service stores and supply stores carry a complete parts stock, pickup and deliver, or make emergency field repairs. Special tools protect tubes and parts being repaired. Call the Sales and Service Store near you:

Drumright, Oklahoma—Ph. 462
Edmond, Oklahoma—Ph. 126
Eureka, Kansas—Ph. GI 3-5132
Healdton, Oklahoma—Ph. 668
Heidelberg, Mississippi—Ph. 3871
Kilgore, Texas—Ph. 3614
Natchez, Mississippi—Ph. 4795
Oil City, Mississippi—Ph. 4615
Reed City, Michigan—Ph. Tenn-2-2461
Seminole, Oklahoma—Ph. 610
Shidler, Oklahoma—Ph. SWift 3-2011
Stephens, Arkansas—Ph. ST 6-5487
Vivian, Louisiana—Ph. 375-2018

SUPPLY STORES
B-H Pump Service, Selman City, Tex. Ph. 5-2035
John & Paul Pump & Supply, Gladewater, Tex. Ph. 2777
Kemp Oil Well Supply, Gainesville, Tex. Ph. HO 5-5112
Mid States Machinery Co., Salem, Ill., Ph. 282
Midway Pipe & Supply Co., Greggton, Tex. Ph. PL 9-5114
Superior Iron Wks. & Supply Co., Tinsley, Miss. Ph. 403
W-B Pump & Supply Co., Pampa, Tex. Ph. MO 4-2223

OR call the factory in Okmulgee, Phone 2164

Thompson PUMP COMPANY
Drawer 591 Okmulgee, Okla.

SOMETHING NEW

HAS BEEN ADDED

NEW HAR HYDRAULIC WIRE LINE STRIPPER PASSES RUGGED TESTS

The thoroughly tested KING HAR will increase safety on your rig . . . with more convenience and less lost time.
Exclusive patented auto-release mechanism
Activated easily from PLATFORM LEVEL
Save time, promote safety with the PROVEN KING oil saver.

For full details on the NEW HAR HYDRAULIC WIRE LINE STRIPPER, write, wire or phone:

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For more data on advertised products, use cards, last page.

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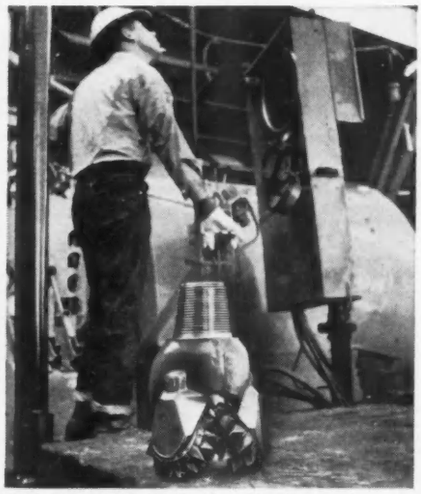
ARE YOUR "DULLS" IN GOOD CONDITION?

Check out any CP "dull." You'll find tooth wear is uniform . . . no nubs or kicked-out cutters . . . cones that run free and true with no jammed bearings, no wobble.

These conditions are your best proof of our footage-producing tooth and bearing designs...exacting metallurgical controls . . . precise manufacturing standards.

The healthy condition of our "dulls" is your assurance of dependable performance in all formations.

At CP we know that you've "no time for downtime!"



GET THE HOLE-MAKING ABILITY you figured on from every bit you use. You can when you know it carries the CP trademark.

Chicago Pneumatic
FORT WORTH, TEXAS

BITS • DRILL COLLARS
REAMERS • TOOL JOINTS

Associations

Guests of Houston Nomads

Guests at a recent meeting of the Houston Nomads included (standing, left to right): Maurice Galtier and Girrard Saul, Lanque Docienne Drilling Co., Paris, France, and W. R. Rieter, Reed Roller Bit Co., Beirut, Lebanon; seated: Arturo Moretti, Empresa Petrolera Fiscal, Talara, Peru; Robert Rieter, Houston, and Maurice Bove, Forex Drilling Co., Paris, France.

Chairmen Named for 1962 Meeting of Midwest SEG

General chairman Paul H. Ledyard, Mid-Continent Geophysical Co., has announced the appointment of group chairmen and co-chairmen for the 15th Annual Midwestern Exploration Meeting to be held at the Hotel Texas in Fort Worth on March 15 and 16, 1962.

William L. Gupton, consulting geologist, of Fort Worth is general co-chairman of the meeting. Other appointments are: Walter D. Baird, consulting geophysicist, program chairman; Castle J. Harvey, Texas Pacific Coal and Oil Co., program co-chairman; Floyd Acklin, Jr., Perry R. Bass, arrangements co-chairman; Howard Itten, Empire Geophysical, Inc., finance chairman; and T. F. Newman, Pan American Petroleum Corp., finance co-chairman.

Ledyard said that the midwestern sections of the Society of Exploration Geophysicists located in Shreveport, Dallas, Fort Worth, Oklahoma City, Midland, and Tulsa will be joined by the Fort Worth Geological Society as sponsors of the meeting.

Dallas Geologists Elect John Clayton President

John M. Clayton, Jr., independent geologist, has been elected 1961-62 president of the Dallas Geological Society. First vice president is Joseph W. Lea of Sun Oil Co.

Other officers: George W. Wilson, Concho Petroleum Co., second vice president; R. L. Foree, Jr., Foree Drilling Co., secretary; Robert G. Cox, Standard Oil Company of Texas, treasurer, and Edgar K. Kraus (retired), The Atlantic Refining Co., past president.

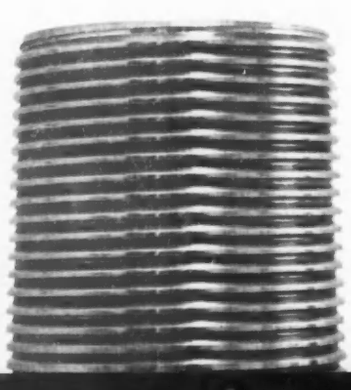
Oil Producers Agency Re-Elects Von Hagen President

Richard R. Von Hagen was re-elected president of Oil Producers Agency of California at the annual meeting of the independent oil producers association's Board of Directors. Von Hagen is president of Lloyd Corporation, Limited.

Vice presidents re-elected were: H. D. Campbell, president of McElroy Ranch Company; John H. Matkin, vice president of Kern County Land Company; Lee S. Osborne, vice president of Union Pacific Railroad Company, and C. G. Williams, Vice President of Universal Consolidated Oil Company. Ross McCollum, president of National Oil Company was re-elected secretary-treasurer and T. D. Bonney, president of Mt. Diablo Company was re-elected assistant secretary-treasurer. Stark Fox was re-elected executive vice president.

Directors re-elected are: T. D. Bonney, president of Mt. Diablo Co.; J. H. Gilliland, president Gilliland Oil Company; E. B. Hall, president of E. B. Hall & Company; H. R. Hamilton, president of Huntington State Company, E. H. Jones, president of Terminal Oil Company; Lee S. Osborne, vice president of Union Pacific Railroad Company; E. E. Pyles, vice president of Monterey Division of Humble Oil & Refining Company; Jasper Tully, president of Reserve Oil and Gas Company; Clark N. Simm, general manager of Producing Properties, Inc., (West Coast Division); L. I. Weill, president of Jewett Oil Company and C. G. Williams, vice president of Universal Consolidated Oil Company. Russell H. Green, Jr., of Signal Oil & Gas Company, was a new member elected to the Board.

This machine bites clean.



The strength of any tubing joint depends a lot on how tight the joint makes up. The joint must have perfect threads. That's why National Tube has installed this special carbide threading machine to thread oil country tubing (2" to 4½" O.D.). The high-speed carbide tools cut threads that are the cleanest, strongest, most accurate ever produced. So, naturally they make a tighter connection.

National Tube uses two other carbide-tooled machines in this threading line—a profiler that

cleans the cutting surface, and a facer that end-faces, bevels and reams out the pipe. All three machines are linked into one continuous operation to produce perfect threads.

Carbide threading is only one of the many "extras" that National Tube uses to produce high quality seamless oil country tubing. Consider USS National Tubing for your next tubing installation.

USS and NATIONAL are registered trademarks

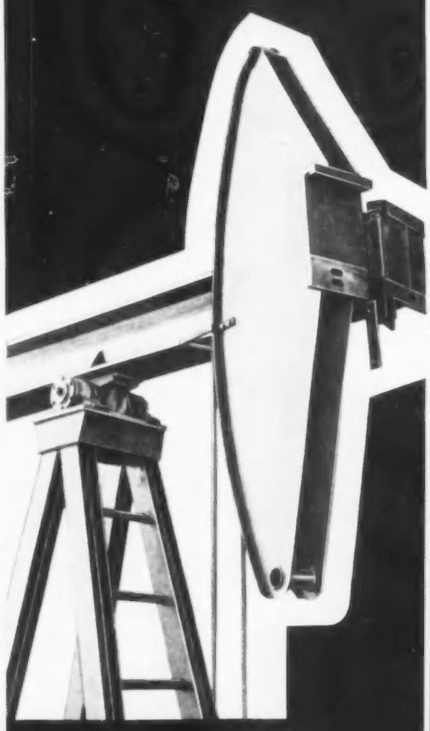
This mark tells you a product is made of modern, dependable Steel.

National Tube Division of United States Steel

Columbia-Geneva Steel Division—San Francisco, Pacific Coast Distributors • United States Steel Export Company, New York

SMG

SALZGITTER Pumping Units
cut costs of production



SALZGITTER MASCHINEN
AKTIENGESELLSCHAFT SALZGITTER-BAD
3441 telex: samag sgtr 0953805 samag

Suppliers' notes

George Young has been named sales-service representative for **Oil Center Tool Company** at Hobbs, N. M. Also **Denali Services Co.,** Anchorage, recently organized by **Wm. F. McClure** and **G. H. Osborn,** has been appointed sales representative for O-C-T in Alaska.

A. H. Quay and **W. Tom Pearson** have been named vice presidents of **Atlas Bradford Company.** Quay will be in charge of marketing, Pearson heading sales. **Bill Myers** is manager of Atlas Bradford's new store in Ozona, Texas. **T. H. Wellman** is salesman in the area.

Alfred H. Cercone has been named manager, Parts Service, Marketing Services Group, **Worthington Corporation,** Harrison, N. J. **Bob D. Keeth** has joined Worthington's equipment sales organization in South Texas with headquarters in Houston. **J. R. L. Williams** has been elected vice president, European Operations, for Worthington. His headquarters are in Paris, France.

Gentry Adams has been transferred to Great Bend, Kansas, as manager of **The Bovaird Supply Company** store. **R. E. Batchelor, Jr.,** is the new manager of the Liberal, Kansas, store, and **W. F. McIlvain** has been moved to Farmington, N. M., as store manager.

Welton R. Baxter has joined **Rector Well Equipment Company** as field and sales representative. He will work from the Wichita Falls, Texas, office.

Charles L. Rhodes is the new branch manager for **Black, Sivalls & Bryson, Inc.,** in Hobbs, N. M.

Technical Oil Tool Corp. has added two sales and service specialists: **B. Ray Lummus** in the Shreveport, La., area and **Arnold F. Koenig** in Casper, Wyo.

Charles R. Brown has been assigned to the South Texas sales area by **Drilling Equipment Manufacturing Company. Bob Davis** is DEMCO's new representative in Houma, La., and **W. A. (Al) Moore** has been named California representative, working out of Bakersfield.

K. K. Litman, formerly area manager of **Baroid Division National Lead Company's** East Louisiana Gulf Coast Area, has been appointed area manager of the company's newly formed Louisiana Gulf Coast Area. **L. T. Weber, Jr.,** formerly manager, **Baroid of Canada, Ltd.,** Area, in Calgary, has been appointed area sales manager of the Louisiana Gulf Coast. Also, **C. W. Felker** has been named assistant area manager in Lafayette of the Louisiana Gulf Coast Area. **R. E. Killion** has been appointed manager of the Baroid Canada, Ltd., Area. **W. T. Shaerman** has been appointed district superintendent at the Endinburg-McAllen, Texas, District. **W. D. Watson** was named area manager of Baroid's West Texas Area; **S. D. Wiginton, Jr.,** appointed sales representative in Dallas; **J. M. Bugbee, Jr.,** appointed area manager of the newly created Tri-State Area, and **W. C. Kellogg** has been trasferred to Houston as assistant area manager of the Lower Texas Gulf Coast Area.

C. W. Felker

W. C. Kellogg

Henry A. (Red) Coleman, Abilene (Texas) Division, **Jim B. Gardner,** Corpus Christi (Texas) Sales Office, and **Herbert A. Bergman,** New Orleans (Louisiana) Sales Office, have been named assistants to the sales manager for **BJ Service, Inc.**

Jones & Laughlin Supply Division has announced assignment of four new store managers: **K. E. Manford** at Corpus Christi, Texas; **B. T. Collins** at Laurel, Miss., and **W. F. Rice,** Pleasanton, Texas. **S. A. Windham** is the new J&L salesman in the Shreveport, La., store.

Dennis M. Frauenberger has joined

Byron Jackson Holds Annual Sales Meeting

Attending the annual sales meeting of Byron Jackson Tools, Inc., held recently in Houston, were (top row, left to right): I. B. Bryan, R. T. Todd, R. T. Harcus, A. R. Boyd, A. W. Rose (President of Byron Jackson Division of Borg-Warner Corporation), W. C. Brooks, V. J. Carter, W. F. Roberts, Jr., and O. J. File. Bottom row: A. E. Jordan, R. E. Leasure, J. F. Buckner, J. P. Kirby, H. C. Starr, P. A. Jordan, G. F. Nicolson, R. J. Evans, Jr., and J. S. Smith. Also present but not shown in the photo were Dr. B. W. Gamson, V. W. Hillyard, R. G. Taylor, Jr., and John Ramsey.

Southwest Industries, Inc., to serve as a sales engineer.

John Erwing and **William W. Chapman** have joined the engineering staff of **Tyson Smith Company.** Erwing will serve as a process engineer and Chapman will work primarily in sales and services.

Michael S. Redford has been named chief geophysicist for the Aero Service Group, a worldwide complex of integrated air survey companies by **Aero Service Corporation.**

R. C. Rieder has become associated with **Continental-Emsco Company** as vice president in charge of Manufacturing and Engineering. Also, **Raleigh Hortenstine, Jr.,** has joined the headquarters staff of the firm in Dallas as vice president and assistant to the president.

George E. Conner, president of **Milwhite Mud Sales Company,** has been elected a director of **Mississippi River Fuel Corporation.**

R. L. Vingoe

G. E. Conner

Ronald L. Vingoe has been appointed chief field engineer of the Tubular Department, **National Supply Division, Armco Steel Corporation.**

Arnold H. Stephens has been appointed **Grove Valve and Regulator Company's** Southern California district manager for sales of valves and regulators.

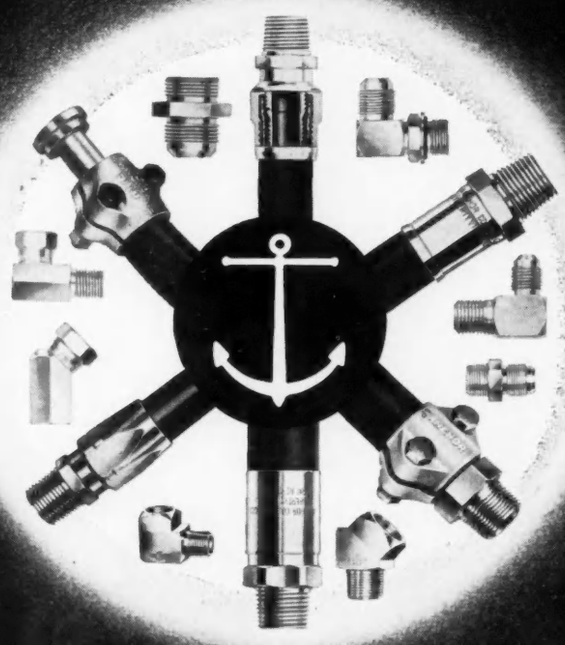
W. G. (Bill) Pitzel has joined **Pennant, Inc.,** of Tulsa, as sales and service representative.

J. L. (Bud) Pearce has been appointed sales engineer for **Otis Pressure Control, Inc.,** the Canadian Division of **Otis Engineering Corporation** of Dallas. Pearce will make his headquarters in Calgary.

N. S. Kendall has been appointed as assistant to **Tyson Smith,** president of **Smith Industries, Inc.**

J. P. Nielson has been advanced by the Sales Department of **Axelson-Garrett, Division of U.S. Industries, Inc.,** to manager of Product Sales. Other promotions include: **J. T. Conner,** remaining as manager of Product Sales for gas lift, lease automation, wellhead safety systems and related product lines; **W. K. Woodward,** new manager of Sales Administration; **Neal V. Fowler** promoted to manager of Industrial Sales, and **R.**

Now...LOCALLY...



You CAN GET

Anchor's Complete Line of REUSABLE COUPLINGS, HOSE and FITTINGS.

For *replacement* use . . . stock items for immediate delivery from your Anchor distributor... Anchor's complete line of hydraulic hose assemblies, hose couplings and related fittings.

The "standard" for original equipment... Anchor Reusable Couplings, Hose and Fittings for *replacements* prove their reliability and dependability for every fluid power application.

With Anchor's complete line of Reusable Couplings, Hose and Fittings you get products designed and built for long, severe service life.

Your nearest Anchor distributor will help keep your fluid power equipment operating continuously... Anchor *replacement* parts eliminate downtime!

IN THE FIELD ON THE ROAD IN THE SHOP

Andy Anchor says: "Anchor's complete line of Reusable Couplings, Hose and Fittings are described in descriptive literature. Get your copy from your Anchor distributor . . . or write direct."

ANCHOR Coupling Co. Inc.

Box 111, Dept. MM, Libertyville, Ill.
Branch Plants: Dallas, Tex., Plymouth, Mich.

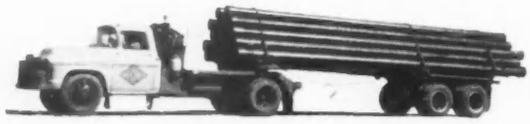
FIRST FOR YEARS IN O. E. M. – NOW . . . FIRST IN REPLACEMENT

Congrats and $25 to Peter Fernandez, Texaco T'Dad Inc. 18 Concord Road Pointe-a-Pierre Trinidad, W.I.

Joe Roughneck is apt to set up a howl, too, if asked to handle steel pipe that is less than superior.

More and more experienced oil and gas men have switched to Lone Star API casing, tubing and line pipe, because it's "tough, top quality and delivered fast." Your best guarantee of rugged API standards is Lone Star's uncompromising quality control.

Neighbor, wherever you are, specify Lone Star and we both get a good deal.



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Lone Star STEEL COMPANY

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W. Mockingbird Lane at Roper • P. O. Box 12226 • Dallas, Texas
DISTRICT SALES OFFICES
912 Republic National Bank Building, Dallas, Texas
Houston, Texas | Midland, Texas | Tulsa, Oklahoma

Suppliers' notes

V. McAfee, appointed manager of Sales Promotion and Training.

Eldon E. Carlson has been named western product manager of **Rockwell Manufacturing Company's** Petroleum & Industrial Meter Division. Carlson will headquarter in Pittsburgh.

S. W. Pearce

C. B. Greer

G. H. Tausch

A. A. Hughes

Sam Pearce, formerly vice president, Sales, has been named senior vice president of **Camco, Incorporated.** Other appointments include **Cecil B. Greer** who has moved up to vice president, Sales; **Gilbert H. Tausch,** promoted to vice president, Research and Engineering, and **Albert A. Hughes,** appointed vice president, Production.

H. F. Dunaway, field salesman at Snyder, Texas, for **National Supply Division, Armco Steel Corporation,** has been appointed store manager at Big Spring. **Oran D. Nash,** store manager, Big Spring, transferred to Abilene, and **Herbert N. Seigler,** store manager at Abilene, has transferred to Wichita Falls.

Roscoe O. Hambric heads the Marketing Group—Machinery and Miscellaneous Merchandise, recently set up by **Continental-Emsco Company. Robert M. Erskine** has been named sales manager of the new group, and **Harry Hobbs, Jr.,** has been named merchandising manager.

M. C. Griffin has been promoted to manager of **Visco Products Company's** Mid-Continent Region. Griffin succeeds **M. P. Hilbun** who has been advanced to general manager of Visco, a subsidiary of **Nalco Chemical Company,** Chicago.

C. D. Fletcher has retired from **Merla Tool Corporation** and **Lewis J. Bicking, Jr.,** has been appointed sales manager of the firm.

If you're caught in the cost squeeze

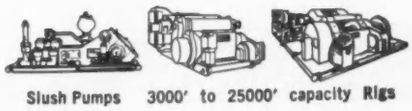
Get the facts about WINCHMOBILE JR.

Wilson

Before you buy get the facts on light weight... low cost... long life Winchmobile Junior with the cross mounted engine which saves moving parts and increases hp to the drum by 15%!

WILSON MFG. CO., INC.
Wichita Falls, Texas • The Home of RED IRON

Winchmobiles Traveling Blocks Speedwinches



Slush Pumps 3000' to 25000' capacity Rigs

Suppliers' notes

Robert J. Shoffstall has been appointed as assistant district engineer, Machinery Equipment Sales and Service, for the **Oil Well Supply Division of U.S. Steel Corporation.** Shoffstall will be located at Midland, Texas.

L. R. Groves

Leslie R. Groves, Lt. General, U.S. Army (Retired), former head of the Manhattan Project has been elected a director of **The Cooper-Bessemer Corporation.** General Groves will fill the unexpired term of **F. C. Van Cleef,** who has retired from the board.

R. T. Miller has been appointed managing director, and A. George appointed assistant managing director of **Fletcher Miller Ltd.,** a member of the **Castrol Group of Companies.**

Thomas F. Casey, Jr., has been appointed account executive for the Mid-Continent Region and **William H. Moody** has been named resident manager of the Tulsa sales office of **Black, Sivalls & Bryson, Inc.** At the same time, **Edward W. Reif** was named regional sales manager of the Mid-Continent Region.

Ted E. Frisbie has joined **Rector Well Equipment Company** as field sales and service representative. Frisbie will be working out of the Casper. Wyo., office which is a branch of Rector's Denver office headed by **M. G. Davis.** Also, it was announced that **Marion M. Bell** has joined the company as sales representative working out of the Midland, Texas, office.

C. L. Wallace, former salesman at Brookhaven, Miss., for **Jones & Laughlin Supply Division,** has been appointed store manager at Brookhaven, and **W. C. Blackledge,** former salesman at Natchez, Miss., has been appointed store manager there.

Clint Cross has been elected vice president in charge of manufacturing for **W. C. Norris Division, Dover Corporation,** succeeding the retired **R. A. Colgin.**

Lee Guill, formerly Eastern Regional sales manager, **Chiksan Company,** has been appointed vice president and sales manager. Also, **Gus M. Bagnard** was appointed vice president and will continue as chief engineer, and **E. Nelmes Thomas** was appointed vice president of Chiksan International, and will continue as manager of Sales Development for Chiksan. Chiksan is a subsidiary of **Food Machinery and Chemical Corporation.**

Jean-Didier Herrenschmidt and **Pierre Jousse** have been appointed to the staff of the new **Ken International S.A.** office in

Nowadays to make a PROFIT You've Got to Cut COSTS

For Deep Production or Shallow

METAL PUMP	BMW NU-TEX
① Price $541.37	$285.56
② Production 72 Bbls	87
③ Repair Cost $147.80	$61.50
④ Pulling Cost	SAME
⑤ Pumping Power Cost	SAME

Adds up to PROFIT Multiplied by number of wells on your lease. and don't throw away your old pump . . . CONVERT IT! Specify only BMW at your Supply Store.

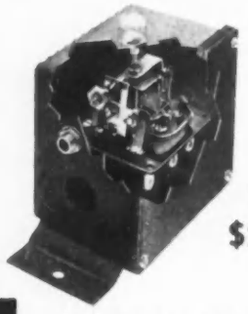
OUR 50th YEAR

The only manufacturer of Soft Packed Pumps Exclusively

BMW
BRADFORD MOTOR WORKS

BRADFORD MOTOR WORKS
General Office and Factory
Bradford, Pennsylvania
Branch Office and Factory Tulsa, Oklahoma
Warehouse Odessa, Texas
Excell Specialty Co.
Edmonton, Alberta, Can.

VIBRATION and SHOCK SWITCH!



VS-1
$29.50

Explosion Proof add $23.50.

MURPHY

Sensitive to abnormal oscillation in two planes of motion, recommended for use on engines, pumps, pumping units, compressors or any other equipment subject to destructive motion.

Same model can be wired to ground ignition, sound alarm, activate control panel lights, or operate valves such as Diesel fuel shut-off valves, and electric motor controller circuits. Rated at 5 Amps, 110 V AC.

•

Also safety switch-gauges to protect engines and equipment against any type of malfunction.

Time, temperature, pressure, level controls, automatic engine or motor controllers and complete control panels.

At your engine dealers or write:

FRANK W. MURPHY MANUFACTURER, INC.
P.O. BOX 4007
RANCH ACRES STATION
TULSA, OKLAHOMA
•
MURPHY SAFETY SWITCH OF CALIFORNIA
11812 Davenport Road • Los Alamitos, Calif.

Suppliers' notes

Paris, France. Herrenschmidt was elected president and general manager of Ken International, and Jousse, an engineering graduate from the Ecole Nationale d'Arts et Metiers, was appointed assistant manager.

Leroy E. Fullingim, former store manager, now district D+B specialist of **Continental-Emsco Company's** Houston district, headquartered in Houston. Also, **Billie L. Lewey,** former D+B specialist, has been promoted to store manager at Luling, Texas; **James E. Cooper,** formerly a field salesman, was promoted to store manager at Tatum, N.M.; **Ronald M. Young,** former D+B specialist trainee, is now a D+B specialist at Daisetta, Texas; **R. H. Trimble** has been hired as a D+B specialist at El Dorado, Ark. Two Continental-Emsco employes recently changed to different locations. **Thomas A. Mann,** division sucker rod specialist, Oklahoma City, has moved to Tulsa, and **Miller F. Mofferr,** D+B specialist, has moved from Alice to Daisetta, Texas.

Harold J. Bourgeois has been named store manager at Eunice, La., for the **Oil Well Supply Division of U.S. Steel.** Other personnel changes include **John J. Boslet** as sales representative, store area, Beatyville, Ky., and **James A. Durham** store manager at Clarksburg, W. Va.

Noah E. Hull, assistant to the vice president-manufacturing, **Hughes Tool Company,** is retiring after 15 years with Hughes and 35 years in the ranks of professional engineers.

M. E. Montrose, senior vice president and general manager, Hughes Tool Company, in announcing Mr. Hull's retirement, termed him one of the nation's most dedicated engineers.

Harry E. Rogers, who has retired as vice president, manufacturing, **Hughes Tool Co.,** will continue as a member of the board and will serve Hughes as a special consultant. **Arthur H. Wooler** succeeds Rogers.

John Laspia, Jr., is the new manager of the Washington, D. C. office of **U.S. Industries, Inc.**

G. S. Leonard has been appointed manager of manufacturing of the Pressure Control Equipment Division of **Cameron Iron Works, Inc.,** in Houston.

Charles M. Struffolino is the new field engineer at Columbus, Ohio, for the **Tubular Sales Department, National Supply Division, Armco Steel Corp.**

Robert M. (Bob) Pearson is now a special representative of **Nordberg Mfg. Co.** in the Great Lakes District.

Corley White has been named sales representative of the **George E. Failing Co.** in the Hattiesburg, Miss., branch store.

Let R-u-b-b-e-r Take The Wear in your sucker rod pumps

IT COSTS YOU LESS THAT WAY

! MARTIN RUBBER & DUCK RINGS give excellent life in dirty abrasive fluids . . . high or low gravity . . . much or little water . . . shallow or deep wells. They last for years in the easier pumping wells. Replacement rings cost comparatively little.

! MARTIN PLUNGER BODIES, precision grooved, drilled and threaded (no underneath fluid passage), usually last for years. Tube or barrel costs are often cut in half.

! The replaceable SYNTHETIC RUBBER GUIDES in MARTIN CAGES last longer than any metal, and the cushioning of the ball increases your ball & seat life. Results are often truly amazing. (Patent No. 2,591,174)

Write for our new catalog or see it in the Composite (24th Edition). All products sold thru supply companies.

JOHN N. MARTIN
Manufacturer
9 W. BRADY STREET • TULSA, OKLAHOMA

Suppliers' notes

Richard Adams has been appointed general manager of a newly created engineering division of **Castrol Limited.** The new Castrol Engineering Division incorporates the following four departments: Lubrequipment, **J. J. Brookman,** manager; Mechanical Appliances, **L. J. Field,** manager; Service, **H. J. Christmas,** manager, and Drawing Office, **J. R. Moores,** chief draftsman. **S. G. Aves** is senior buyer for the division and **G. Meredith** is the office manager.

B. G. Barefield has been appointed sales manager for **Oil Center Tool Company's** Rocky Mountain District with headquarters in Casper, Wyo. At the same time, **Jerry Boyd** was named sales manager at O-C-T's Four Corners District with offices in Farmington, N.M.

Tom S. Andrews, Jr., has been appointed product manager-Hamer products for **Well Equipment Mfg. Corporation.** In his new position, Andrews will coordinate sales activities on Hamer Line Blind Valves and Plug valves through their representatives and distributors throughout the United States.

T. S. Andrews, Jr.

DYNAQUIP Buys Pumping Line from Axelson-Garrett

DYNAQUIP, Long Beach, Calif., announces the purchase from Axelson-Garrett, Division of U.S. Industries, Inc., of the Hydrax hydraulic pumping unit line. The engineering, sales and service personnel, as well as inventory, warehouse and service facilities, have been taken over by DYNAQUIP from Axelson-Garrett.

All Hydrax units previously sold will now be serviced by DYNAQUIP from sales and service points at Long Beach and Bakersfield, Calif.; Odessa, Texas; Shreveport, La. and Casper, Wyo. The main manufacturing plant is in Long Beach.

Magcobar Forms New Gulf Coast Region

Formation of a new Magcobar Texas Gulf Coast Marketing Region has been announced by I. W. Hoskins, senior vice president, marketing.

Hoskins said the new region was formed by consolidating the personnel, equipment, and facilities of Magcobar's Texas Gulf Coast Region, a sales and service organization with headquarters at Houston, and Kaffie Lumber & Bulk Barites, Inc., of Corpus Christi.

Headquarters will be located temporarily at 1319 Agnes Street in Corpus Christi.

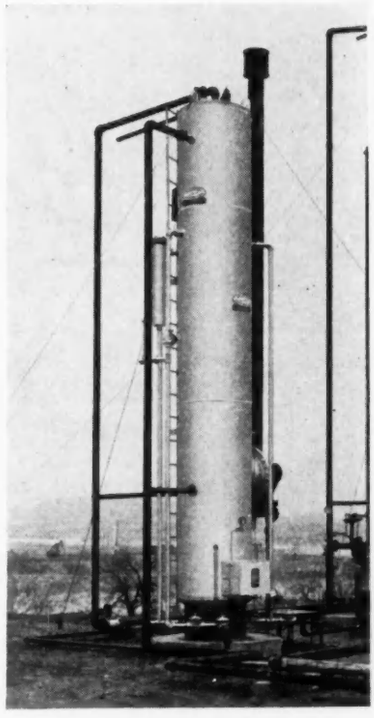
METROL®
Metering Treaters

METROL® Metering Treaters provide efficient separation of oil and water emulsions and accurately measure the oil and water in two integral metering chambers in the lower portion of the vessel.

Metering Treaters achieve greater economy by incorporating several functions into a single vessel. A Metering Treater will serve as an Oil and Gas Separator, a Free Water Knockout, an Emulsion Treater, and Oil and Water Meters. Thus, a Metering Treater can be used in place of several other separate pieces of equipment to obtain savings in equipment cost.

Free Water removal in the upper separating chamber on these Metering Treaters is an optional feature. Oil-Water Interface Control in these units is maintained by a Weir or by Float-Operated Pilot and Valve.

METROL Metering Treaters are equipped with high capacity heating tubes that eliminate "hot-spots" and thus prevent fire tube failures. Also, these units are equipped with trouble-free and safe combustion control equipment to prevent "Blow-outs" and "Flashback."



METROL Model 36 MT-0020 VWK Metering Treater

Emulsions in most areas can be treated by these units without excelsior. However, excelsior can be furnished in these Metering Treaters in case it is needed or wanted.

METROL's design experience, combined with qualified field service, assures the producer of dependable and trouble-free operation.

METROL Metering Treaters are available in either vertical or horizontal type of construction, and in working pressures of 25, 50, and 100 psi.

If you have an emulsion treating problem where you wish to meter the oil and water, you will save money by using METROL Metering Treaters. Please write us for details.

SPECIFICATIONS AND CAPACITIES

Outside Diameter	Shell Length	Heating Capacity BTU/Hr	Working Pressure psi	Capacities
3′	20′—0″	200,000	25, 50, & 100	Settling and metering capacities for these units will be furnished upon request.
4′	20′—0″	400,000	25, 50, & 100	
6′	20′—0″	600,000	25, 50, & 100	
8′	22′—0″	1,200,000	25, and 50	
10′	22′—0″	1,800,000	25, and 50	

U. S. Patent No. 2,818,738

® Trade Mark Registered U. S. Patent Office

We solicit your inquiries.

Every Unit is completely assembled, pressure tested, calibrated, and performance tested prior to shipment.

Competent Sales and Service Representatives located in all major oil areas.

OIL METERING and Processing EQUIPMENT CORP.
MELROSE 5-1226 • 4843 YALE STREET
HOUSTON 18, TEXAS

P.O. Box 10777, Houston 18, Texas

SQUEAKS

From the Bull Wheel

WORLD OIL

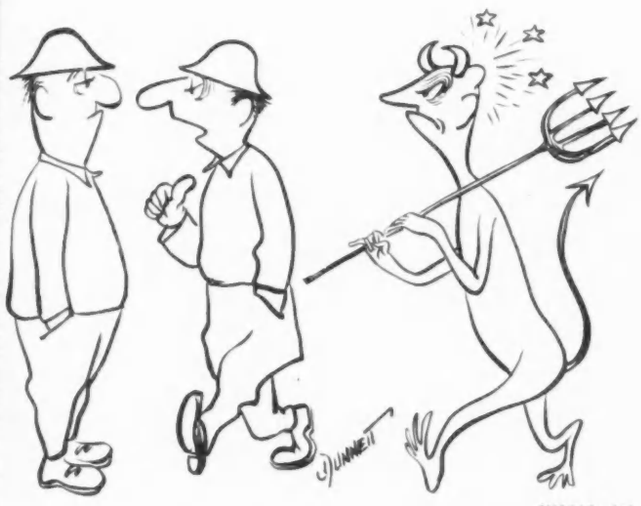
"Well, in view of this, Alec, I think we can grant your loan."

WORLD OIL

"I assume you're in charge of offshore operations."

WORLD OIL

"Do you remember how many barrels of oil you ate?"



WORLD OIL

"This guy says we're drilling through his property!"

McCULLOUGH SALINITY LOG

with scintillometer®

...a nuclear log that tells OIL *from* SALT WATER

The McCullough Salinity Log determines the presence and degree of saline fluids in formations surrounding the bore-hole. It will distinguish between oil and salt water and can be used in open or cased hole. Providing hole diameter is not extreme, it may be used where air or gas or highly saline fluid was used for drilling.

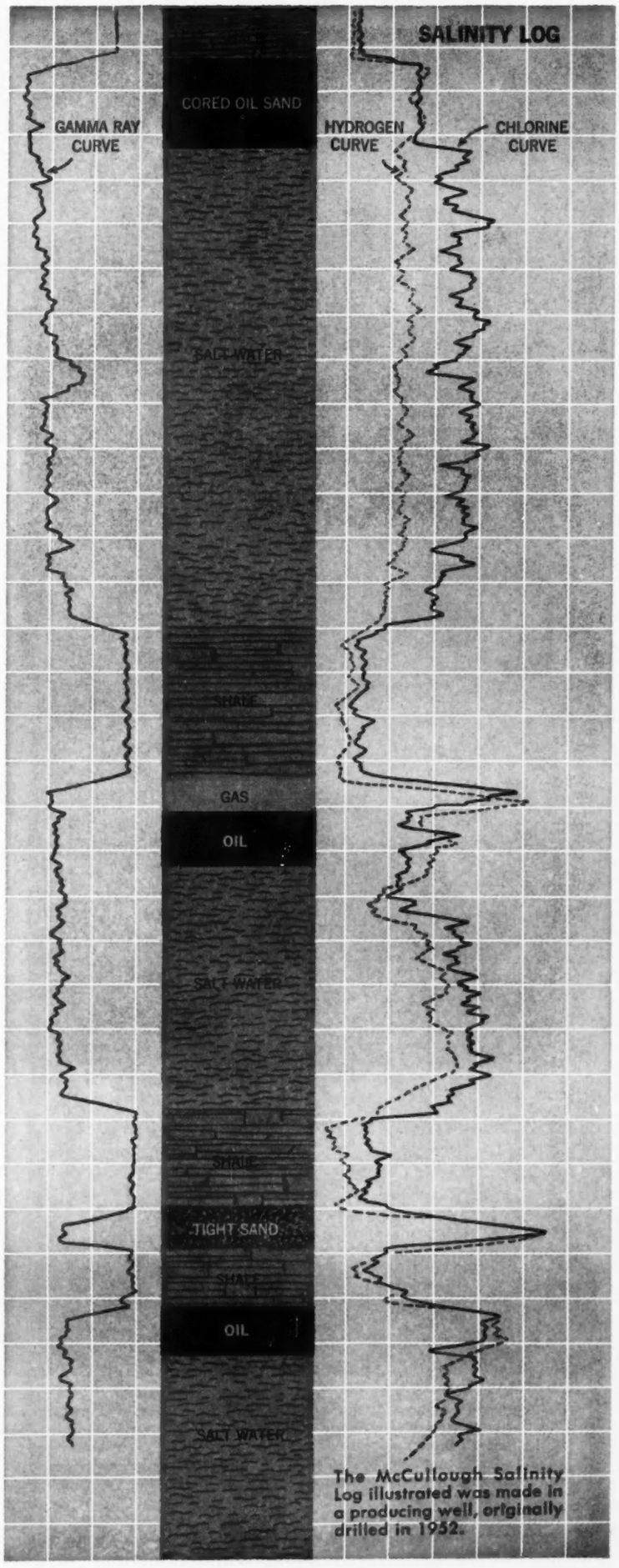
A "chlorine" curve and a "hydrogen" curve are recorded simultaneously at the same depth elevation with a single detector. These curves are compared to indicate the amount of salt, NaCl in particular, that is present in the formations being investigated. In potential oil bearing formations the absence of salt is indicative of the presence of oil.

The recording of the two curves simultaneously is considered essential. It eliminates the possibility of a depth discrepancy between two curves which are recorded separately. It also insures the recording of information under identical physical conditions—of extreme importance in interpreting the two curves.

A higher counting rate and greater instrument efficiency allows an increased spacing (23½ in.) between the source and the Scintillometer. This provides the added benefit of a proportionately larger zone of investigation.

Take a look at these features:

- **Distinguishes between salt water and oil in liquid bearing formations.**
- **Determines the degree of salinity in formation fluid.**
- **Identifies salt water zones that must be blanked off.**
- **Makes possible water saturation calculations for potential oil bearing zones.**
- **Shows salt water and oil zone contact under suitable conditions.**
- **Aids in determining gas/oil contact.**
- **Helps determine if it is economically practical to set casing on new completions.**
- **Aids in evaluating correct depth to set casing string.**
- **Accurately re-evaluates old wells to locate potential cased-off production.**
- **A reliable tool for porosity determination.**



The McCullough Salinity Log illustrated was made in a producing well, originally drilled in 1952.

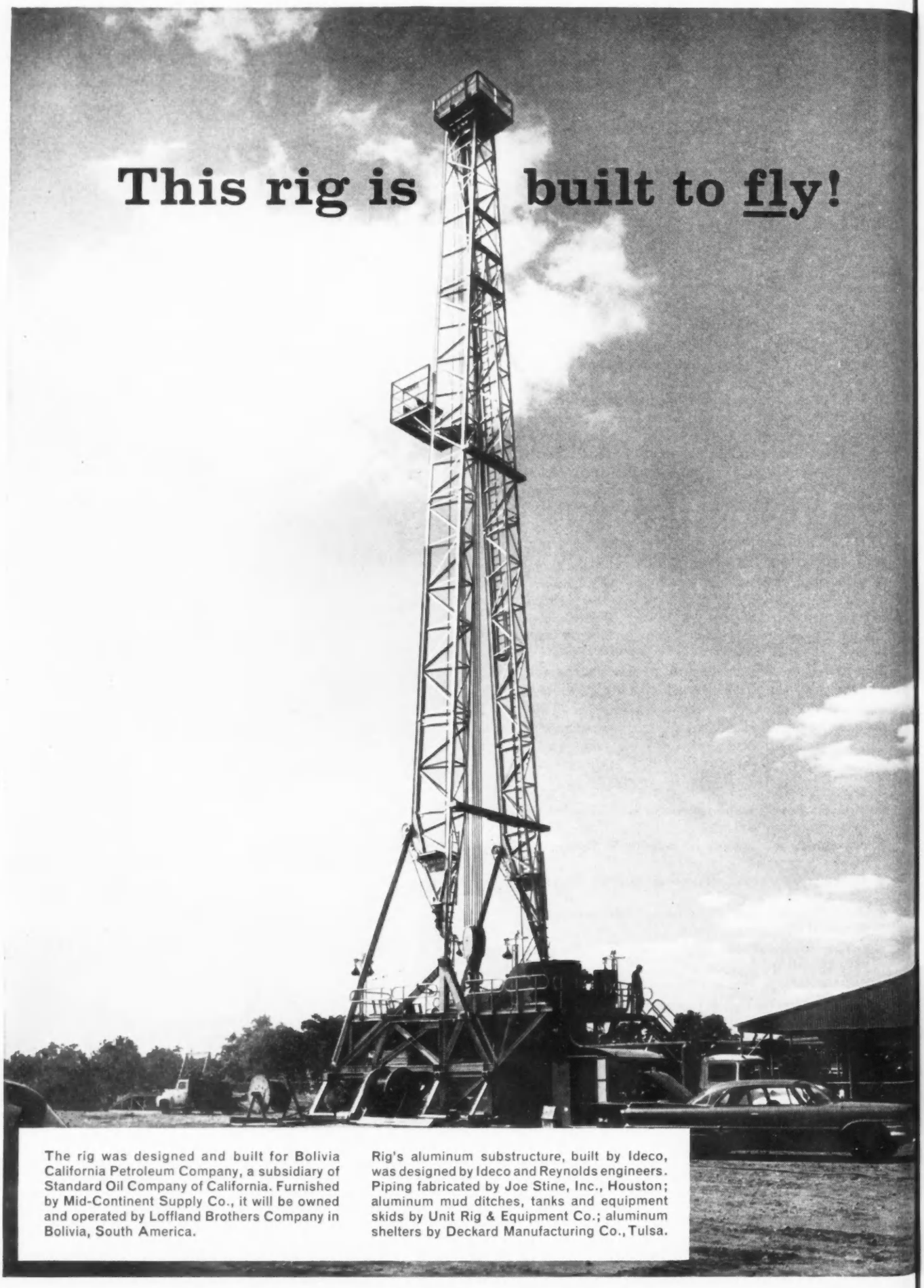
McCullough

TOOL COMPANY

Los Angeles • Houston • Edmonton

Cable Address: MACTOOL

For more data on advertised products, use cards, last page.



The rig was designed and built for Bolivia California Petroleum Company, a subsidiary of Standard Oil Company of California. Furnished by Mid-Continent Supply Co., it will be owned and operated by Loffland Brothers Company in Bolivia, South America.

Rig's aluminum substructure, built by Ideco, was designed by Ideco and Reynolds engineers. Piping fabricated by Joe Stine, Inc., Houston; aluminum mud ditches, tanks and equipment skids by Unit Rig & Equipment Co.; aluminum shelters by Deckard Manufacturing Co., Tulsa.

...made with strong, lightweight Reynolds Aluminum

The rig shown opposite is light enough to *fly*—and it will, by cargo plane or helicopter, to remote drilling sites in South America.

Light as it is, it can handle a 350,000 lb. hook load with a concurrent pipe setback load of 150,000 lbs. This new rig has a depth capacity of 15,000 ft. with 3½" drill pipe.

Explanation: Except for the mast, the major components of the rig are made with strong, lightweight Reynolds Aluminum. Reynolds supplied the aluminum and worked closely with the fabricators in designing this equipment.

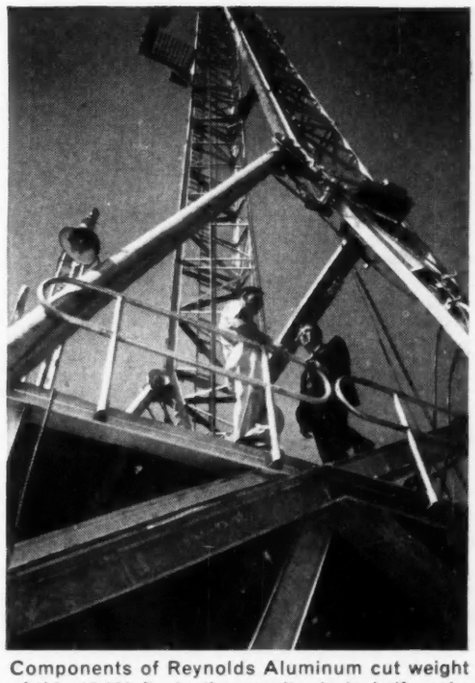
The aluminum sub-structure, which saves 60% of the weight of an equivalent steel base, was designed by Ideco in close cooperation with Reynolds engineers. The crow's nest, handrails, finger board, racking platforms, and water and mud suction lines are also made of Reynolds Aluminum. Unit Rig & Equipment Co. fabricated the aluminum mud ditches, tanks, and equipment skids.

Thanks to its extensive use of Reynolds Aluminum and other special design features, the rig weighs less than 400,000 lbs.—about half as much as an equal conventional rig. This makes it practical for exploration teams to fly the rig in sections to drilling sites wherever they can land a cargo plane or helicopter.

And the Reynolds Aluminum in the rig will serve longer, with less maintenance, than steel. Aluminum resists corrosion from drilling muds; it won't rust.

The lightweight strength and corrosion resistance that Reynolds Aluminum adds to the air-borne drilling rig are paying important dividends throughout the petroleum industry—in drilling, refining, transportation, and marketing. And you can get immediate service, experienced technical assistance—as well as metal—from Reynolds.

For details on the new rig or on any use of aluminum, contact your local Reynolds office, or write *Reynolds Metals Company, Richmond 18, Virginia.*



Components of Reynolds Aluminum cut weight of this 15,000 ft. depth capacity rig in half, make it suitable for air transport to remote drill sites.

Note to Oil Field Equipment Manufacturers:

Initial material cost doesn't fully determine product end cost. Aluminum's light weight, ease of fabrication, and corrosion resistance often mean lower final costs. Contact the leader in developing aluminum applications for the oil industry—Reynolds. Call the Reynolds office nearest you or write *Reynolds Metals Company, P.O. Box 2346-CE, Richmond 18, Va.*

REYNOLDS ALUMINUM

Watch Reynolds TV show "Harrigan & Son", Fridays—ABC-TV

SQUEAKS
From the Bull Wheel

Do You Read Me?
"Pilot to control tower. Pilot to control tower. Please give me landing instructions."

"Control tower to pilot. Why are you yelling so loud?"

"Pilot to control tower. I have no radio."

It's Really Rough, Boy
Lewie (after hooking a shot into the creek): "I'm certainly not playing the game I usually play."

Caddy: "What game is that, sir?"

Cat Calls
When a woman, indulging in rich canapes, commented that she had to watch her waist line, her very catty friend purred, "And how fortunate you are to have it right out there where you can."

Necessities of Life
The personnel manager handed an applicant a card with five words on it—*Man, Woman, Eggs, Carpet, Loving.* "Which one of these words does not belong? he asked.

"Loving," said the applicant. "You can beat a man, beat a woman, beat eggs, beat a carpet, but you can't beat loving."

More Truth Than Fiction
An Internal Revenue man is writing a book "How We Made $1,800,000 Off the Fellow Who Wrote a Book About Making $2,000,000 in the Stock Market."

Now You Know
The difference between Communism and Democracy is—Plenty.

Our Younger Years
Angry Father: "Young man, what's the idea of bringing in my daughter at 4:00 a.m.?"

Suitor: "It started to rain."

To Be Sure
We hear that a lot of enterprising young engineers are spending much of their valuable time tinkering with misses in their motors.

SECONDARY RECOVERY

PETROLEUM ENGINEERS
STEPHENS ENGINEERING
WICHITA FALLS, TEXAS

RESERVOIR ENGINEERING
Water Flooding Gas Repressuring
EVALUATION CORE ANALYSIS
SURVEYS ECONOMICS
Cost Estimates, Design, Installation
FIELD SUPERVISION
Phone 723-2167

Suppliers' notes

W. F. Krause

W. F. (Bill) Krause has been named sales engineer by McMurry Oil Tool Specialties, Inc., Houston. His duties will include establishment of new sales areas as part of a McMurry expansion program. Krause is a University of Houston graduate and has had more than 12 years experience in the oil industry.

Barnwell Offshore Forms New Cantex Corporation
Barnwell Offshore, Inc., of Shreveport, La., has announced the recent formation of Cantex Corporation, a fully owned subsidiary, to specialize in a loss circulation material to be used in mud systems for the oil industry, with their feature product known as Pheno-Seal.

Charles H. (Chuck) Dresser, Jr., of Houston, formerly with Milwhite Mud Sales Company, was named executive vice president of the new firm. R. J. (Bill) Robbins, vice president and general manager of Barnwell Offshore, Inc., is president, and R. S. Barnwell, Jr., is chairman of the board.

The new firm will office in the Texas National Bank Building in Houston.

Grant Oil Tool Appoints Three Firms as Representatives
Grant Oil Tool Company has appointed three prominent drilling equipment sales and service firms to represent the company in French, Middle Eastern and Argentinian oil fields.

S. N. Marep of Paris will represent Grant in France, North Africa and the Franc area countries. Macridge Petroleum Equipment Supply Company of Beirut will sell and service Grant tools in Lebanon and the Middle East. Argentine representative is Drillex of Buenos Aires.

The three representatives will facilitate deliveries and service for Grant's line of reamers, stabilizers, hole enlargers and other downhole tools. The firms also will provide liasion between customers and Grant engineers when special needs or drilling problems arise.

Manuscripts Wanted

Have you written a book you would like to have published? Do you have an idea or an outline that you would like to talk over with a publisher? Gulf Publishing Company, publishers of World Oil, Petroleum Refiner and Pipe Line Industry magazines, and numerous technical books, is actively seeking trade and technical manuscripts for publication by its rapidly expanding Book Division. For further information write to Manager, Book Publishing, Gulf Publishing Company, P. O. Box 2608, Houston 1, Texas.

WORLD OIL'S Trading Post
CLASSIFIED ADVERTISING

RATES: Regular Classified (undisplayed) set in this size type: 20 cents per word. Minimum charge $4. Blind box address in our care counts six words. Replies forwarded without charge. **Display Classified ads,** set in suitably larger type with ruled border, $13.50 per column inch. Ten percent discount for two or more insertions of same copy in consecutive issues. **All Classified ads payable in advance.** Copy deadline: Twelfth of month preceeding date of issue. Send copy and checks to: Trading Post Classified Section, World Oil, P. O. Box 2608, Houston 1, Texas.

EQUIPMENT WANTED

WANTED

8" and 10" used or new surplus steel pipe couplings, 8 thd., with or without dutchmen, any quantity, any area. Immediate inspection & prompt pickup with our own trucks. Write, wire or phone collect:

GEORGE BARBER
VALLEY STEEL PRODUCTS CO.
5901 S. Lamar DALLAS 15, Texas
PHONE COLLECT: HA 8-1301

HELP WANTED

Reservoir Engineers

The Operating Companies of the Oil Consortium in IRAN have openings for qualified Reservoir Engineers possessing not less than 8 years post-graduate Petroleum Engineering experience, the last 5 of which should have been devoted to specialized reservoir engineering functions.
Salary, $13,550-$16,000 net after income tax. Biennial 72 days home vacations plus travel time, housing available, families may accompany. Replies will be held in confidence, write:

Box 518-H
RADIO CITY STATION
NEW YORK 19, N. Y.

FOR SALE

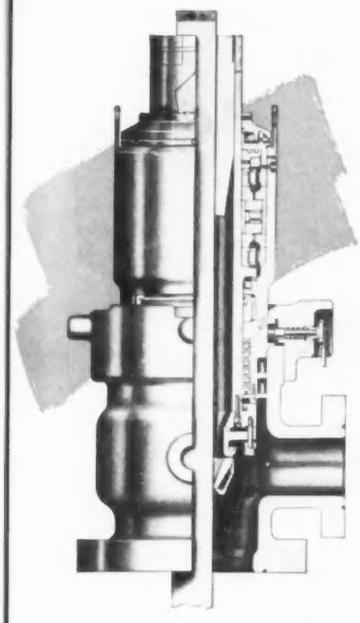
■ **100,000 acres of Ohio and West Virginia Oil and Gas Leases in Appalachian Basin Area for immediate sale in the multi-million acre lease play scattered in and through major companies' holdings, specializing in 50 to 60 thousand acre blocks. David Law, 716 Union Trust Building, Parkersburg, West Virginia.**

SITUATIONS WANTED

■ SUBSURFACE GEOLOGIST. Living in Europe desires responsible position. Did you discover a new oil field? I am your man to do subsurface geology, propose new well locations and develop field. Ten years successful oil experience in VENEZUELA, Colombia, Bolivia and USA as **subsurface geologist,** field geologist, micropaleontologist, well site and consultant in major and small companies. Nine years experience as practical geologist. Ph.D. I am tough and like accurate, conscientious work. Speak and write fluently Swiss German (mother tongue), high German, English, French, Spanish; some Italian. Prefer warm countries and aggressive, small or middle size company. Box BB 227-W, WORLD OIL, Box 2608, Houston, Texas, U.S.A.

DRILLING WITH AIR?...GAS?...MUD?...REVERSE CIRCULATION?

YOU SELECT THE METHOD...



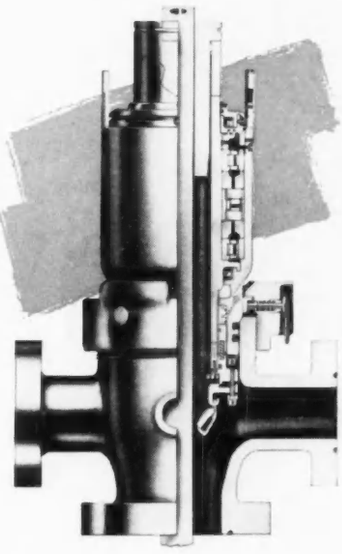
USE THE TYPE 50
FOR HEAVY-DUTY WORK
—including all types of drilling operations through 10¾" casing and larger!

The SHAFFER ROTATING BLOWOUT PREVENTER and STRIPPER Gives FULL PRESSURE PROTECTION

AUTOMATICALLY!

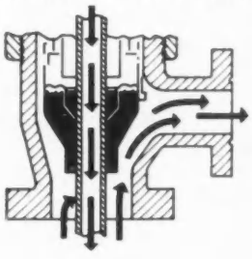
It's easy to see why the Shaffer Rotating Blowout Preventer and Stripper is the ideal pressure control solution to so many of today's advanced drilling techniques . . .

- Here's a unit that is *always* sealed off around the drill string as long as pipe is in the hole!
- It maintains its pressure-tight seal around *any* element in the drill string—square, hexagonal or octagonal kellys, flush joint, upset or coupled drill pipe, tool joints and drill collars (excepting, of course, such abnormally large diameter drill string tools as bits, reamers, scrapers and similar units).
- There's no delay when pressure emergencies threaten because the Rotating Blowout Preventer is *always* ready. No valves to open or close. No levers to operate. Nothing to remember—or forget—in emergencies!



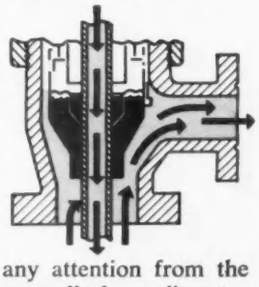
USE THE TYPE 51
FOR SLIM-HOLE DRILLING
—also for drilling-in, for production and re-work jobs, and for similar applications.

DRILLING WITH AIR OR GAS?



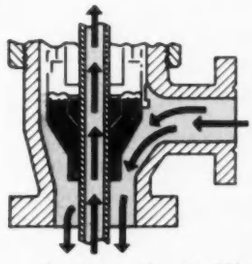
Operators are finding that many formations can be drilled faster, with longer bit life and increased production recovery by using compressed air or gas to replace the conventional mud column. Even wells in excess of 18,000 feet deep have been successfully drilled by this method, using the Shaffer Rotating Blowout Preventer and Stripper to seal around the drill string and maintain safe pressure control. The unit not only permits wells to be drilled more safely, but it also can readily be adapted to function as a casing stripper for pressure control while running casing, if desired. The 44 page brochure shown at right gives full details!

. . . AND FOR NORMAL OPERATIONS!



If yours are the more conventional drilling procedures, you still can do the job more efficiently and safely with a Shaffer Rotating Blowout Preventer and Stripper because this unit *automatically* adjusts itself to fit the varying diameters in the drill string without any attention from the operator. And even such abnormally large diameter drill string units as bits, reamers, and scrapers, can be readily passed through the Rotating Blowout Preventer without delay or inconvenience!

WHAT ABOUT REVERSE CIRCULATION?



This is another of the modern drilling techniques that provides important advantages in certain formations. Because the cuttings are returned through the inside of the drill string, higher fluid velocities are obtained at lower pump pressures (therefore lower pressures on the formations). Higher velocities lift larger cuttings, reduce need for coring, save costly rig time. Also, since larger cuttings are carried away faster, bit life is lengthened, drilling speed is increased.
These are advantages worth investigating...and here, again, the Shaffer Rotating Blowout Preventer and Stripper is the ideal unit to control circulation and maintain full pressure protection while drilling!

THIS HELPFUL 44 PAGE BROCHURE provides full data on operation and applications. It's free to qualified personnel, engineers and executives!

38 years OF OIL TOOL LEADERSHIP

SHAFFER

HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

SHAFFER TOOL WORKS: Brea, California • CALIFORNIA SERVICE SHOPS: Santa Fe Springs and Taft
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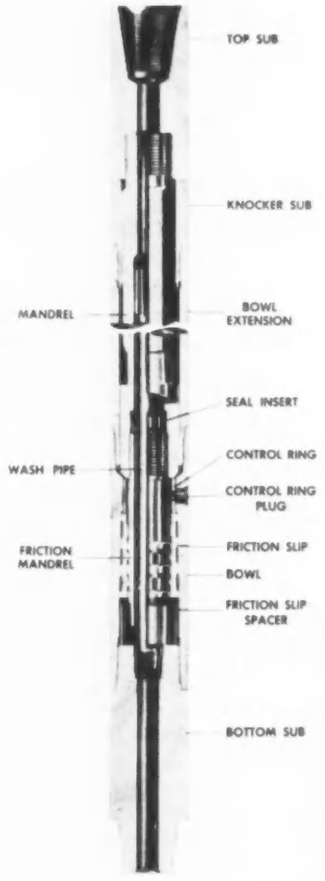
OKLAHOMA CITY, OKLAHOMA, Shaffer Tool Works, 6201 South Shields Boulevard
FARMINGTON, NEW MEXICO, Shaffer Tool Works, Post Office Box 546
CASPER, WYOMING, Shaffer Tool Works, Post Office Box 1788
HOUMA, LOUISIANA, Shaffer Tool Works, Post Office Box 827
EXPORT SALES OFFICE, Shaffer Tool Works, 500 Fifth Avenue, New York, N.Y., U.S.A.
IN CANADA: Shaffer Western Hemisphere, Inc., 5823 103A Street, Edmonton, Alberta.

NEW equipment and services

Three-Stage, Air-Cooled Compressor

This natural gas compressor designed specifically for oil and gas applications is now available. Compact and lightweight, it can be packaged into portable skid-mounted units driven by an engine or electric motor. Manufacturer claims quick payout by sale of excess gas, higher gross volumes of liquid recovery, economical method for lifting isolated wells, and low installation and maintenance costs. Short stroke and resulting low piston speeds means long ring life and less cylinder wear. (Worthington Corp. Supplements data on Pages 3512-3513, 1960-1961 Composite Catalog).

For more data, circle E1 on postcard



BOWEN SURFACE JAR

New Tool to Free Stuck Strings

A new tool for use in freeing stuck downhole strings has been introduced. This Surface Jar, operating from the surface, transmits a sharp downward impact or jar to the downhole string. A simple adjustment allows the impact force to be varied from a very light blow of 3,000 pounds up to a stroke of 50,000 pounds. Length of stroke is 48 inches. This tool is reported to be particularly useful in freeing any stuck downhole string which does not respond to conventional procedure. (Bowen ITCO, Inc. Supplements data on Pages 713-828 & 3165-3184, 1960-1961 Composite Catalog).

For more data, circle E2 on postcard

Tubing With New Joint Design

A new Acme-thread tubing with a non-upset, high strength joint for deep wells and multiple completions has been developed. The manufacturer reports maximum clearance with joint strengths considerably above yield strengths of the tubing body. Dimensions have been reduced from the standard Acme-thread in a 4-to-3 ratio. Threads have been run out completely, extending them on a constant taper to the OD surface of the tubing. (Pittsburgh Steel Co. Supplements data on Pages 4501-4520 & 3393, 1960-1961 Composite Catalog).

For more data, circle E3 on postcard

pump rentals from Dowell

Handle your special pumping jobs economically with powerful, reliable pump trucks run by experienced Dowell operators

All Dowell pump trucks, from the smallest to the largest, are offered on a rental basis. They are practical, economical answers to many special oil field pumping problems.

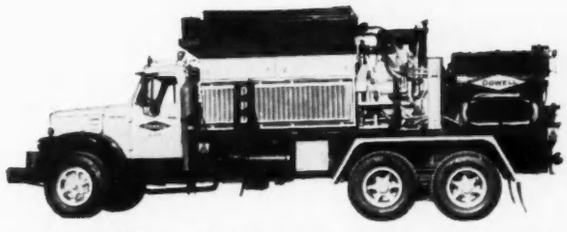
Many operators use these Dowell-designed units for jobs such as killing wells, pumping test plugs, testing casing, circulating, spotting oil, transferring liquids, displacing fluids into formations and for miscellaneous mixing and pumping jobs.

These are the same reliable, heavy-duty pump trucks which Dowell uses in its fracturing, acidizing and cementing services. The reasonable rental charges include the services of an experienced Dowell operator. The next time you have a "do-it-yourself" pumping job, call Dowell. An engineer will help you select a Dowell unit to fit your needs. Dowell services and products are offered in North and South America, Europe, North Africa and Iran. Dowell, Tulsa 14, Oklahoma.

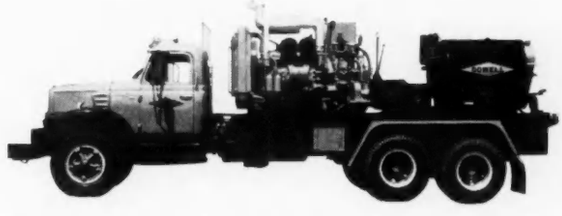
SERVICES FOR THE OIL & GAS INDUSTRY

DOWELL

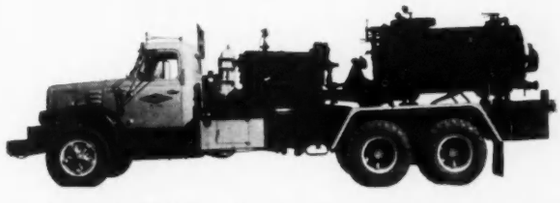
DIVISION OF THE DOW CHEMICAL COMPANY



ALLISON PUMPER. 615 hydraulic horsepower rated output. Pressures up to 10,500 psi. Volumes up to 828 gpm. Operates from remote control panel.

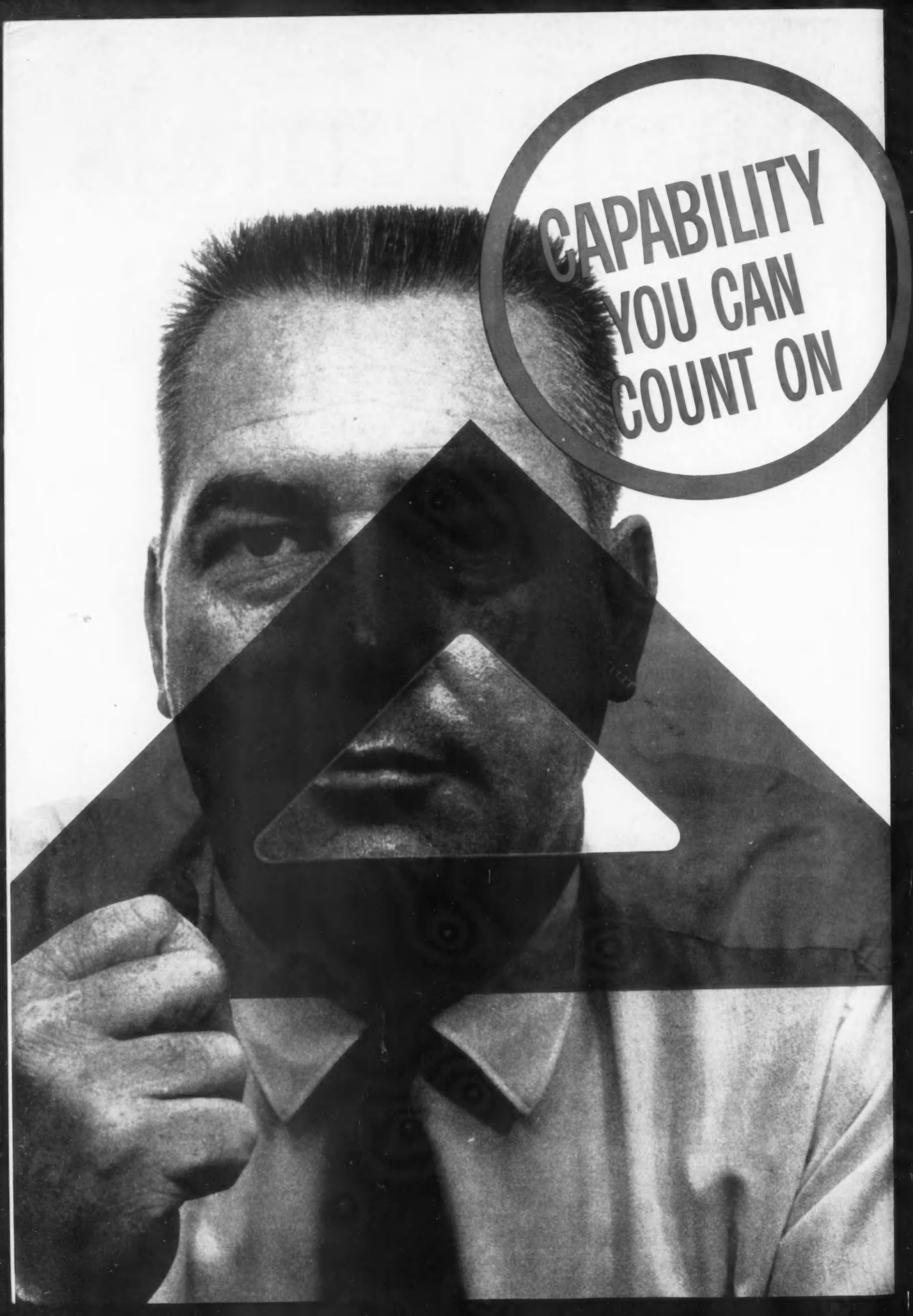


TWIN DIESEL PUMPER. 306 hydraulic horsepower rated output. Pressures up to 10,500 psi. Volumes up to 828 gpm.



DOWELL "TP" PUMPER. 175 hydraulic horsepower rated output. Pressures up to 10,500 psi. Volumes up to 828 gpm.

For more data on advertised products, use cards, last page.


CAPABILITY
YOU CAN
COUNT ON

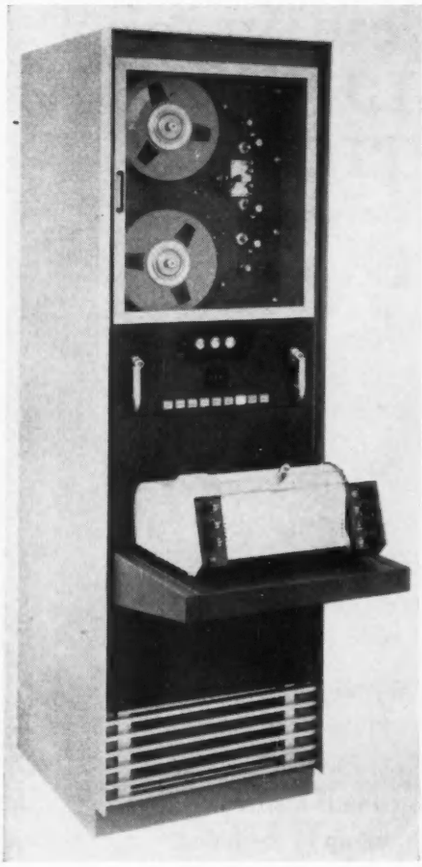
CONTINENTAL'S GOT IT.. *Worldwide!*

As a fully integrated manufacturer and supplier, Continental-Emsco's equipment capability extends far beyond better engineering and design! Continental maintains a highly trained field force to aid engineering in developing equipment with higher efficiency, through extensive field checks. This total responsibility means even better products for you . . faster and at lower cost! Continental's experience, resources and men add up to CAPABILITY you can count on . . worldwide!

CONTINENTAL EMSCO

CONTINENTAL-EMSCO COMPANY, a Division of The Youngstown Sheet and Tube Company
General Offices: Dallas, Texas
Export Office: New York, New York

New equipment



New Tape Plotting System

This new Model 570 magnetic tape plotting system produces an X-Y plot of digital data on a special recorder to plot seismic events, resolved strike dips and other computer outputs. Its completely digital operation eliminates analog conversions or servos and the problems of drift and dynamic response. Equipment is compatible with most digital computers. All types of symbols or characters from 1/10 inches on up may be recorded. (California Computer Products, Inc.).

For more data, circle E4 on postcard

Oil Friction Reducing Agent

A new oil friction-loss reducing agent known as J105 is now available. J105 added to the oil, reduces friction loss from 30 to 70 percent. Agent reduces friction loss by suppressing turbulence and should be effective whenever the turbulent flow of oil is encountered. Development of J105 supplements the water friction-loss reducing agent J100. (Dow Division of The Dow Chemical Company).

For more data, circle E5 on postcard

Slim Hole Insert Pump

New D/B 1-inch bore slim hole insert pump, for use in slim hole pumping wells using 1¼, 1½ and 1¾-inch nominal I.D. tubing string, has been introduced. Design of this pump permits unrestricted filling of the fluid chamber, assuring greater pump efficiency and fluid compression to assist in eliminating gas lock. Features include a precision-honed barrel tube, chrome-plated pin end plunger, armored cages, superloy balls and seats, and a three-cup bottom hold-down. Armored cages are made of a high quality alloy steel which results in longer valve life, according to the manufacturer. (Continental-Emsco. Supplements data on Pages 1397-1484, 1485 & 1559, 1960-1961 Composite Catalog.)

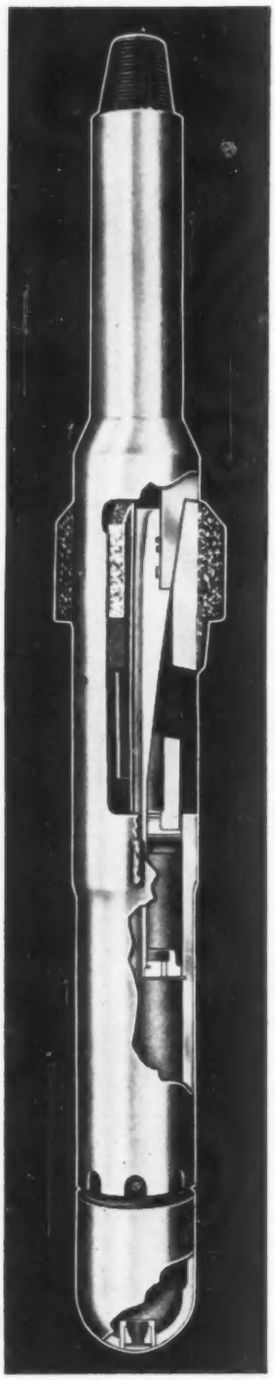
For more data, circle E6 on postcard

Wellhead Equipment

A new line of wellhead equipment for tubingless completions featuring interchangeability of hangers in the same casing head is now available. Single or multiple tubing strings can be suspended either by slips or by threaded mandrels. Single, dual or triple tubingless completions can be handled easily by 10-inch Alco casing heads. Quadruple completions can be accommodated with 12-inch casing heads. Only slips and packing element are necessary to change from threaded to slip suspensions. (Alco Products, Inc. Supplements data on Pages 177-196, 1960-1961 Composite Catalog).

For more data, circle E7 on postcard

AT LAST! A Tool Designed Especially for MILLING SECTIONS



THE GRANT SECTION MILL is the only tool engineered and built for the specific job of milling sections. Nothing can match it for its purpose. It permits savings of *at least* 25% on rework costs over older methods —and makes many a marginal producer worth rescuing. Here's why:

Broad, thick blades faced with fragmented tungsten carbide normally mill 30-foot sections in one trip with cutting surface to spare.

Thick body walls take any torque or side pressure required for milling.

"Body-Lock" design eliminates arms or extensions, prevents cutters from collapsing, bending or breaking.

Positive retraction is assured. The Mill cannot hang up in the hole.

The Grant Section Mill is easy to operate on any rig equipped with a rotary table—on drill pipe or tubing—and by any qualified driller following simple instructions. With only 4 moving parts, it can be inspected and redressed on the rig floor in 15 to 20 minutes. It is simple, rugged and requires practically no body maintenance. Thus, it is ideal for overseas or remote operations.

For full data, see the Grant Section of your Composite Catalog—or write direct!

USED WHERE G PERFORMANCE COUNTS

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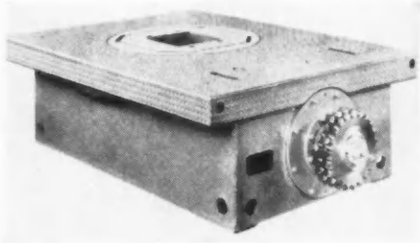


Rotary for Deep Drilling

A new rotary machine for deep drilling has a 27½-inch table opening and 450-ton static load rating. All features of handling, installation, operation and maintenance of company's smaller rectangular rotaries are incorporated in this B-275. Spiral bevel pinion and gear, made of quenched and tempered alloy steel, are matched and lapped for smooth operation. Oil Lubrication is used throughout. Selective, direct table locks, consisting of two independently operated racheting lock pawls that engage slots in rim of the gear, prevent tonging shocks and strain on the pinion, gear and pinion shaft bearings. (National Supply Division, Armco Steel Corp. Supplements data on Pages 3849-3976, 1960-1961 Composite Catalog)

For more data, circle E8 on postcard

New Transcorder

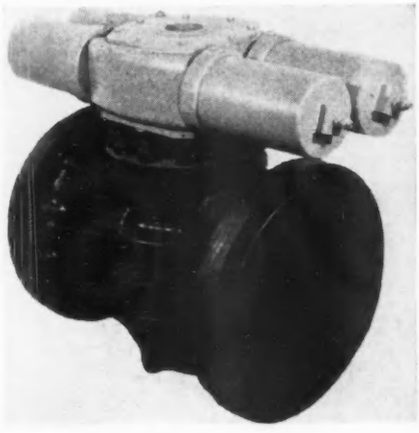
Seismic data can be transcribed from paper records onto magnetic tape with this new Transcorder. It also transcribes recorded data from one size of magnetic tape to another and, with an accessory Transcorder Log Reader, will transcribe well logging data to magnetic tape for use in seismic data reproduction equipment. A reproduction of the seismic trace being transcribed can be produced simultaneously for checking purposes. (Electrodynamic Instrument Corporation).

For more data, circle E9 on postcard

New Butterfly Valve

This Norriseal Wafer Type Butterfly Valve for working pressures to 150 psi is now available with aluminum, aluminum-bronze and ductile iron bodies. Aluminum and aluminum-bronze bodies with double rib type (tangency) design were developed to prevent the collapsing of flanges and are readily adaptable to all types of automatic operators. (W. C. Norris, Manufacturer, Division of Dover Corporation. Supplements data on Pages 4013-4036, 1960-1961 Composite Catalog).

For more data, circle E10 on postcard



New Valve Actuator

The Robotarm valve actuator allows positive remote control of any type of rotary operation of butterfly, ball or plug valves or any device that requires 90—180 degrees rotation. Units are manufactured in several sizes with from 750 to 300,000 inch-pounds of opening and closing torque at 100 psi air pressure. Hydraulically operated, unit is compact, totally enclosed and sealed and can be furnished in some sizes with Fail Safe Spring returns. (Bettis Corporation).

For more data, circle E11 on postcard

BELLISSIMA ROMA

Do Oil Executives translate it "most beautiful," too? *Naturalmente!* Rome is the perfect vacation setting. A jewel of a city . . . polished by the Italian art of good living. And you'll soon find the secret of that art.

Just do as the Romans do—relax and live the good life. Stroll on the Via Veneto. Dine at Alfredo's. Sightsee at St. Peter's, the Forum, the Colosseum. Everywhere you go, you'll discover the joyous, living union of ancient and modern that makes Rome "The Eternal City."

Even a business or professional trip is a vacation in beautiful Rome. Business and pleasure go well together here! Or combine a business meeting anywhere in Europe with a "Roman Holiday." The round-trip fare from New York to Rome, only $484.30 on a 17-day Economy Excursion Fare, effective October 1 to March 31, allows you free stopovers in Paris, London, Munich and many other cities along the way.

But you don't have to wait until you're overseas to enjoy Continental atmosphere. You get your first taste of Europe the moment you're aboard with Air France Jet superservice. English-speaking crews fete you with French service, wines, cuisine and comfort all the way there and back. Departures from New York, Chicago, Los Angeles. For information on special events, vacations, tours and extra cities at no extra fare, see your Travel Agent or send the coupon below.

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683 Fifth Ave., New York 22, N. Y.
Gentlemen: Please send me the following: Free "Coming Events in Europe and Around the World" Booklet. Jet-Away Holiday Kit (complete low-cost vacation tours).

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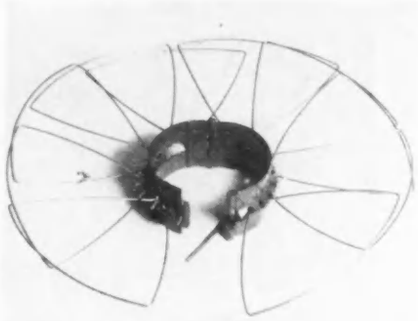
State_____

WO-2

New equipment

RWC Wall Cleaners

A reciprocating wall cleaner for single string 2⅞-inch O.D. tubing completions is now available. Body is 14-gage steel, 3.65-inch O.D. with integral spot-welded hinges for installation. Cleaner is placed around tubing with the overlapping abrading springs pointing up so they can fold inward when tubing is lowered. (Halliburton Co. Supplements data on Pages 2301-2424, 1960-1961 Composite Catalog)

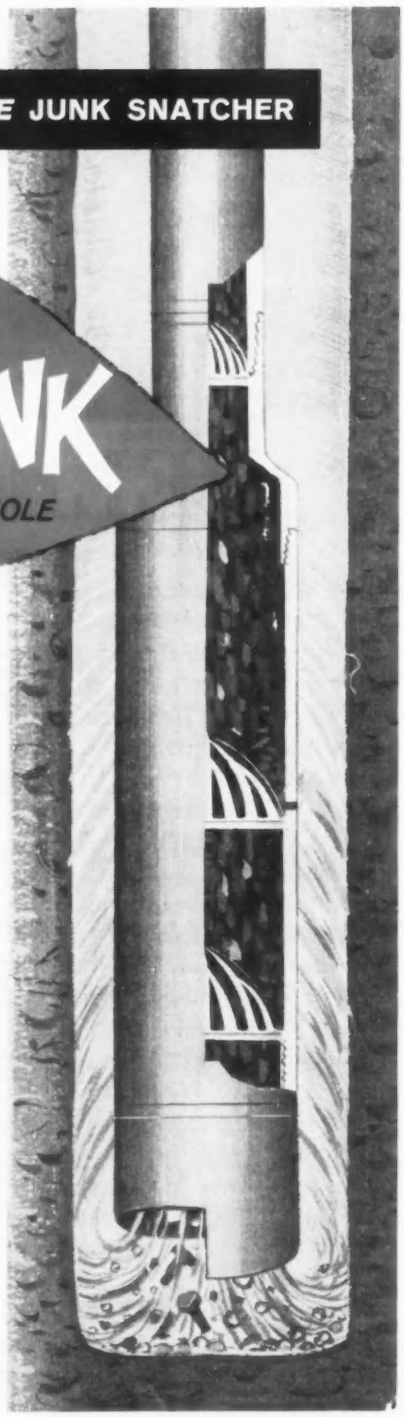


For more data, circle E12 on postcard

THE CAVINS *MULTI-SURGE* JUNK SNATCHER

GOES AFTER JUNK

IN CASING OR OPEN HOLE



GETS THE JUNK

Rubber, brass, plastic, aluminum, wood, and other non-ferrous materials (which could not be touched by magnetic tools).
Pieces of casing, wash pipe, roller shoe, carballoy mill, nipples, tong keys, packer slips, cones, nails, and even 12 feet of chain . . . all recovered by Cavins.

GETS JUNK OUT FAST

Cavins multi-surge action gets MORE junk with FEWER runs! "100 linear feet of sand in one run" . . . "7 gallons of junk in 3 runs" . . . "one run cleans the hole after 4 days of fishing with other types of tools" . . . all routine with CAVINS.

NEXT TIME, CALL CAVINS . . . FIRST

CAVINS

Houston, Texas	HU 6-2821
Kilgore, Texas	3624
Odessa, Texas	FE 2-3982
Corpus Christi, Texas	TU 3-1331
Lake Charles, La.	HE 6-7821
Houma, La.	UP 2-1161
Jackson, Miss.	FL 3-9524

New Frac-Shot

A better way to achieve high fracture conductivities in oil and gas wells by using malleable aluminum particles is now possible, according to an announcement by The Atlantic Refining Company and Reynolds Metals Company. The development, employing aluminum pellets, has proved conclusively that wells fractured with these pellets—called Frac-Shot—can increase output up to 250 percent or more, according to the announcement. (Reynolds Metals Co. Supplements data on Pages 4701-4708, 1960-1961 Composite Catalog.)

For more data, circle E13 on postcard

High Strength Adhesive

Epon "Pipelock" 924, an epoxy adhesive with a breakout torque of over 7,000 foot pounds on a 2⅞-inch tubing joint (24-hour setting time), was developed as a substitute for welding on surface casing joints in order to prevent the casing from backing off while being drilled through. Adhesive joins and seals all steel pipe joints, hardens in a short time and is resistant to high temperatures, salt water, steam and mud. Can reduce drilling costs by eliminating the need for welding time, labor and equipment. (Shell Chemical Co., Adhesive Department).

For more data, circle E14 on postcard

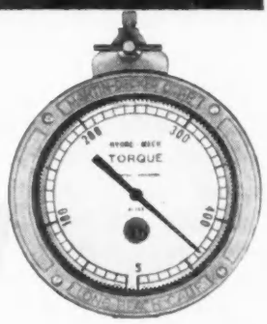
Improved GX Pump Line

New and important features have been added to the 500 HP, 14-inch stroke mud pump of the Gardner-Denver GX line. A steel cast fluid end has now been adopted as standard equipment complete with threaded valve covers and new threaded cylinder heads. Other GX line advantages include positive pressure lubrication, bronze connecting rod and eccentric bearings, and interchangeable fluid cylinders. These features give prolonged pump life and minimizes rig down time. (Gardner-Denver Company. Supplements data on Pages 1993-2028 and 3549-3572, 1960-1961 Composite Catalog.)

For more data, circle E15 on postcard

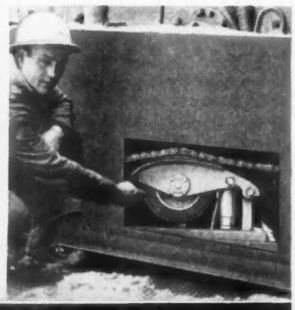
ROTARY TORQUE

for DOWN HOLE VISION



A good Weight Indicator is not enough. For complete knowledge of down hole conditions install the Martin-Decker Hydro-Mech Torque Assembly. This unit fits under the rotary or secondary chain and provides sensitive indications of:

Hole and Bit Conditions
Fishing Operations
Diamond Coring
Air and Gas Drilling



MARTIN DECKER

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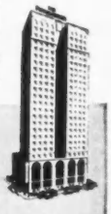
World's principal manufacturer of Oil Well Drilling Instrumentation

Four Fine Facilities in PITTSBURGH

ALLEGHENY MOTOR INN

Opposite Greater Pittsburgh Airport. 60 air-conditioned rooms, tile bath, TV, radio, phone. Superb restaurant and cocktail lounge. Year-round swimming pool. Courtesy car to and from airport. **AMherst 4-7790**



HOTEL PITTSBURGHER

In the heart of the Golden Triangle. 400 outside rooms, bath, radio, TV, air-conditioning. General Forbes Lounge & Dining Room. ATlantic 1-6970

JACKTOWN MOTOR HOTEL

1 mile west of Irwin Interchange on Route 30. 60 air-conditioned rooms with TV, telephone, combination tile baths. Excellent dining room and facilities for group parties. **UNderhill 3-2100**

HOTEL PITTSBURGHER MOTEL

Opposite Greater Pittsburgh Airport. 56 air-conditioned rooms, tile bath, radio, TV, private phone. Courtesy car to and from airport. AMherst 4-5152

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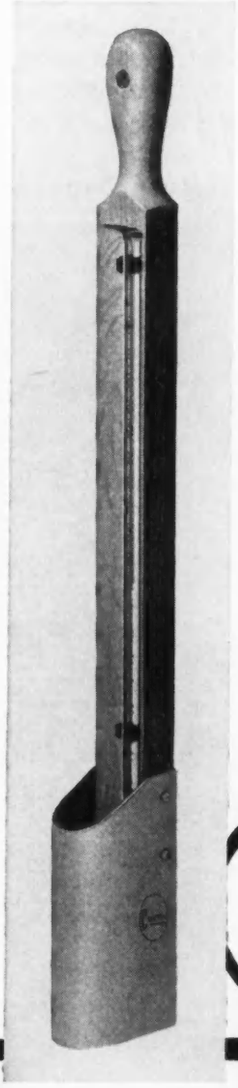
Joseph F. Duddy, Gen. Manager

**Teletype Service. Telephone any Knott Hotel. All Knott Hotels and offices in U.S. connected by teletype.*

Route 30, Lincoln Highway, Shortest Route to Pittsburgh

Curtin's NEW VALVE TYPE Tank Thermometer*



Faster, more accurate than standard cup case

The Curtin Valve Type Tank Thermometer incorporates a bucket valve which opens as the thermometer is lowered into the tank, allowing oil to flush through the cup to keep the mercury column at or near exact temperature of oil. When the thermometer is withdrawn, the bucket valve closes, retaining a sample from the desired level.

Permanent EVERLAST® Graduations are etched in the glass and filled with special pigment—can never fade, peel or dissolve since they are actually *fused* into the glass itself.

Easy to Read—mercury column appears red when viewed through lens-type scale.

Guaranteed Accurate—to within one scale division.

Meets ASTM Specification El.

Finest Hardwood Case resists warping and cracking. Friction clips hold thermometer tube tight but permit easy tube replacement.

* Patent Applied For

Curtin Valve Type Wood Case Tank Thermometers		
16764A2	−30 to 120°F	Each 6.50
16764A4	0 to 180	6.50
†16764A6	20 to 260	6.90
16764A8	170 to 500	7.50

†Conforms to ASTM specification except for range.

For more information write W. H. Curtin and Company, P. O. Box 118, Houston 1, Texas. Ask for Bulletin TH-461.

W. H. CURTIN & CO.

CURTIN

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136

SIMPLIFY TREE CONSTRUCTION . . . AT LOWER COST

W-K-M Cross Type Multiple Completion Gate Valves

These compact multiple gate valves cost less than equivalent components and provide all of the service-proved features of regular W-K-M ® Gate Valves such as non-lubricated operation, Teflon* seat inserts for double-tight sealing, and parallel expanding gates for a positive up and downstream seal.

W-K-M Cross Type Gate Valves are available for dual, triple and quadruple completions. Specify W-K-M — at leading supply stores everywhere. Write for Catalog 200. W-K-M Division of ACF Industries, Inc. P. O. Box 2117, Houston, Texas.

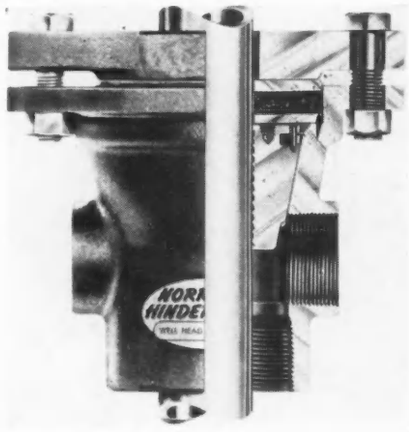
*DuPont's tetrafluorethylene resin

When So Much Depends on a Valve . . . Specify W-K-M.

W-K-M DIVISION

ACF INDUSTRIES

New equipment



New Tubing Head

This new tubing head was designed for use in waterfloods and in areas where lower pressures are encountered. Designated as the type WS Tubing Head, it utilizes slip suspension and will suspend 5,000 feet of 2 inch or 2½-inch tubing. Rated at 1,000 psi test and 500 psi working pressure and available in 4½ or 5½-inch female bottom thread. (W. C. Norris, Mfg., Division of Dover Corp. Supplements data on Pages 4013-4036, 1960-1961 Composite Catalog).

For more data, circle E16 on postcard

Wire Line Stripper

A new wire line stripper has been field-tested and released for production. It uses a hydraulic pump to activate pressure in the stripper. Activation is accomplished with two or three strokes of the hydraulic lever at platform level. An exclusive, patented auto-release mechanism adds to the safety and time-saving features, according to the manufacturer. (King Oil Tools. Supplements data on Pages 3141-3164, 1960-1961 Composite Catalog)

For more data, circle E17 on postcard

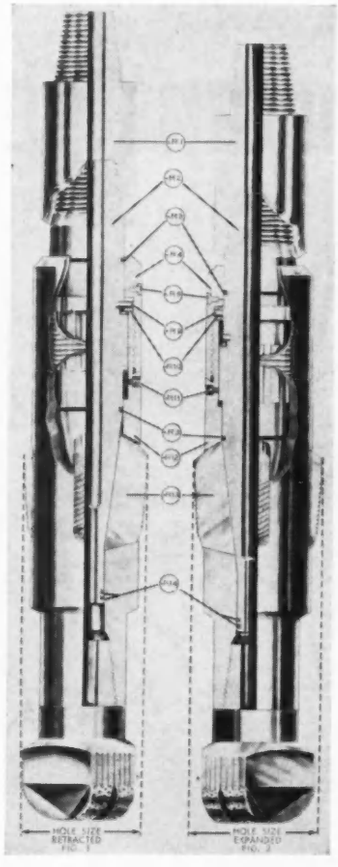
Electric Well-Logging Unit

A new, completely self-contained electric well-logging unit requires no additional equipment and can be used with standard type probes is available. It is lowered into the hole on a simple wire line where it can record two separate traces. Measures 2¾ inches in diameter and 98 inches in length. It carries own batteries; is independent of outside power sources. (Mandrel Industries, Inc., Electro-Technical Labs Division. Supplements data on Page 1741, 1960-1961 Composite Catalog).

For more data, circle E18 on postcard

Expandable Drill Reamer

This positive, mechanically actuated, expandable drill reamer may also be used as an under-reamer. It operates immediately above the bit as an integral part of the drill string, reaming and/or under-reaming simultaneously with the drilling of the



hole; therefore, extra trips and rig time are eliminated when reaming and/or under-reaming. (Drilling & Service, Inc. Supplements data on Pages 1649-1656, 1960-1961 Composite Catalog.)

For more data, circle E19 on postcard

W-K-M Multiple-Completion Valves

W-K-M Multiple-Completion Valves are built with Teflon seat inserts for dead-tight sealing, pressure-seal bonnets, superfinished stems equipped with roller bearings, and sealing surfaces protected from the flow.

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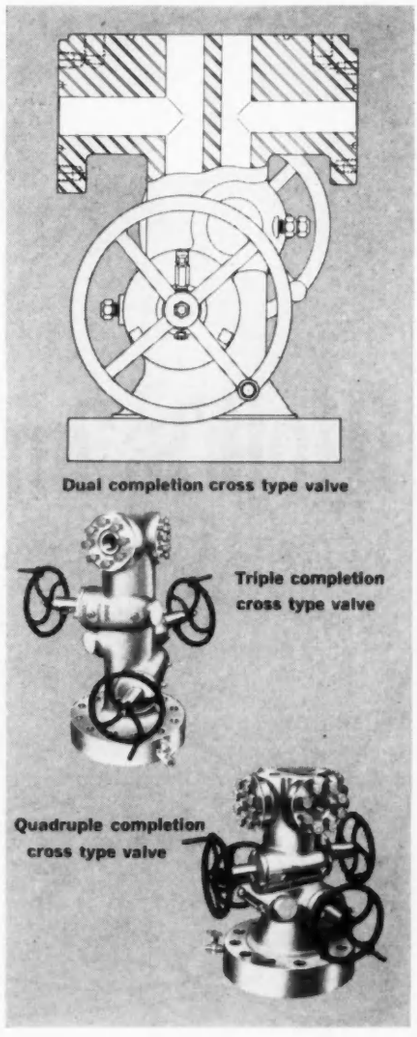

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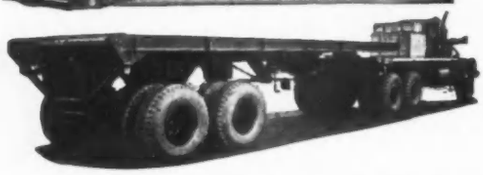
Hands-England 75,000 lb. capacity, tandem axle Oilfield Float 30'0" long and 9'6" wide, folding support legs and inverted 36" fifth wheel.
Truck and Float on Michelin 18.00 x 25. Sahara "X" sand tires.

OILFIELD FLOAT

Hands-England 75,000 lb. capacity tandem axle Oilfield Float 30'0" long and 8'6" wide, folding support legs and inverted 36" fifth wheel.
Float on 11.00 x 20—14-ply tires.



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Scammel Constructor 261" wheel base Oilfield Truck.
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Truck and Float on 14.00 x 20—18-ply tires.

OILFIELD FLOAT

Hands-England 25,000 lb. capacity single axle Oilfield Float 24'0" long and 8'0" wide, folding support legs and SAE king pin 11.00 x 20—12-ply tires. Steel stake sides.

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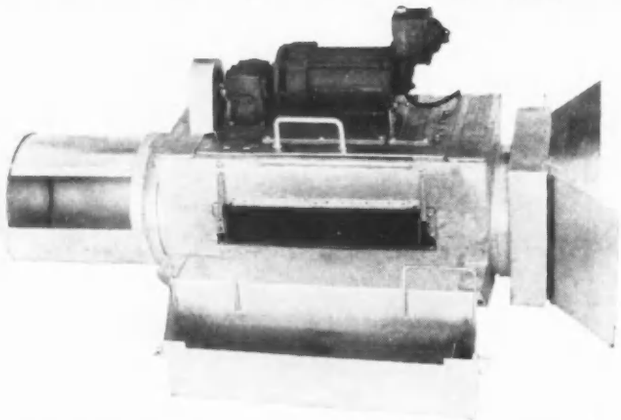

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Contains powerful permanent magnetic element which is rotated electrically by explosion-proof 1/6 hp electric motor. Mud flows through the tool, which automatically removes the steel cuttings from the mud, and discharges them into a removable hopper at the side of the unit. Similar in operation to other K & G Ditch Magnets, with exception of electrical rotation.

For details on K & G Ditch magnets for export, contact K & G home office, Houston.

K&G OIL TOOL AND SERVICE CO., INC.
2703 Sackett Street • Houston 6, Texas • JA 2-5436

New literature

To get your copies, circle key numbers on postcard and mail to WORLD OIL

New Pumping Unit Design

Headlined as a bold new concept in pumping unit design, Bethlehem Steel's new Series "60" pumping unit is fully described and illustrated in a new introductory booklet, now available. Series "60" is clearly explained in the booklet in terms of its service advantages over the conventional design of pumping units.

To get a copy, circle E20 on postcard

New Drawworks

An eight-page brochure is now available from Gardner-Denver on the new 1500 drawworks. Brochure details rig features with cutaway views of brakes, transmission and main drum. Complete specifications and a power flow diagram are included.

To get a copy, circle E21 on postcard

New Logging Program

A new Preferred Logging Program has been issued by Lane-Wells Company to aid logging users in the selection of the right service for the information desired. Program shows at a glance the correct log or combination of logs for every use under various hole conditions.

To get a copy, circle E22 on postcard

Special Fabrications

A 20-page brochure covering the specialities and special fabrications of the manufacturer is now available from Joe Stine, Inc. Among products described include: "lightning" rig skidding equipment, pipe and kelly straightener, various hydraulic jacking mechanisms, dual-purpose bins serving for transportation as well as pipe racks.

To get a copy, circle E23 on postcard

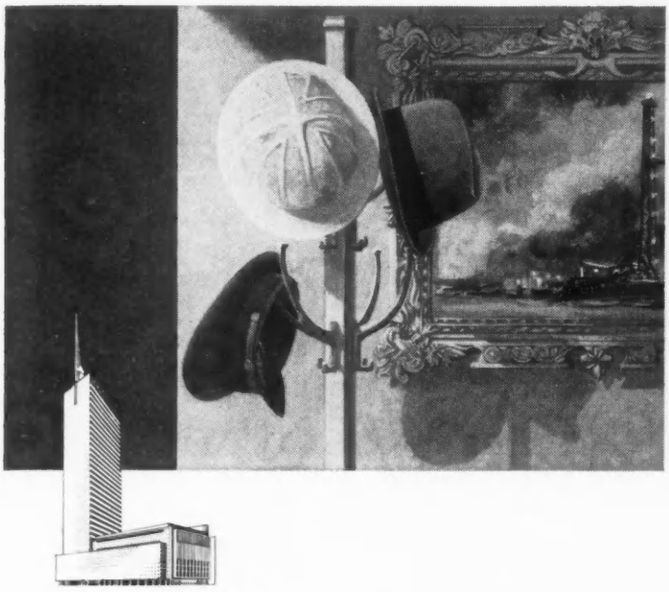
'Zone Finder'

Schlumberger Well Surveying Corporation is offering a new easy method of locating possible oil or gas zones recorded on Sonic and Induction Electrical Logs. The new tool, termed the "Zone Finder," is a circular slide rule. It substitutes for charts which may confuse the oil operator who is not versed in detailed log interpretation.

To get a copy, circle E24 on postcard

R H I A

RANK HAS ITS ADVANTAGES



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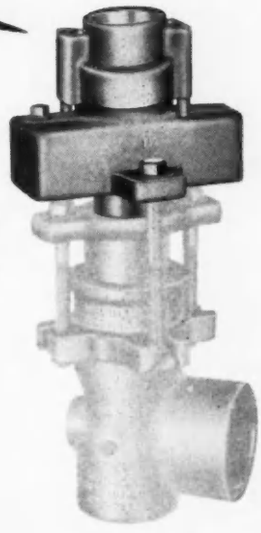
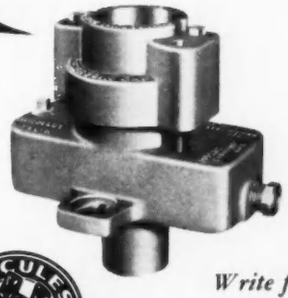
Fits all Hercules Stuffing Boxes and costs only $18.75 to $19.75, complete.





The Hercules Oil Reservoir Upper Gland fits all Hercules Duplex Stuffing Boxes and was designed primarily for use on "problem" wells which pump-off and burn the stuffing box packing. The reservoir capacity is 1 fluid quart. The polished rod moves through the oil in the reservoir which lubricates and cools it. The oil film on the polished rod is controlled on the "up stroke" by the Split Cone Packing Ring (located between the Oil Reservoir Gland Body and the Cap). Excess oil and the dust or sand which invariably collect on the polished rod are wiped off by the Split Cone Packing Ring on the "down stroke." This excess oil and dirt are channeled back into the reservoir by means of the specially-designed Cap. The dirt will settle in the reservoir and can be removed through the drain plug.

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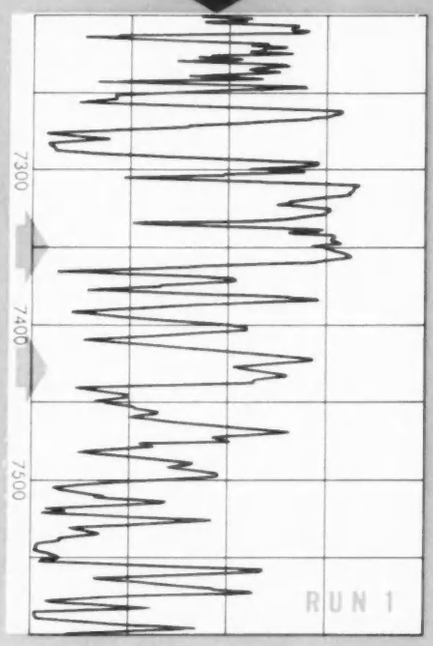
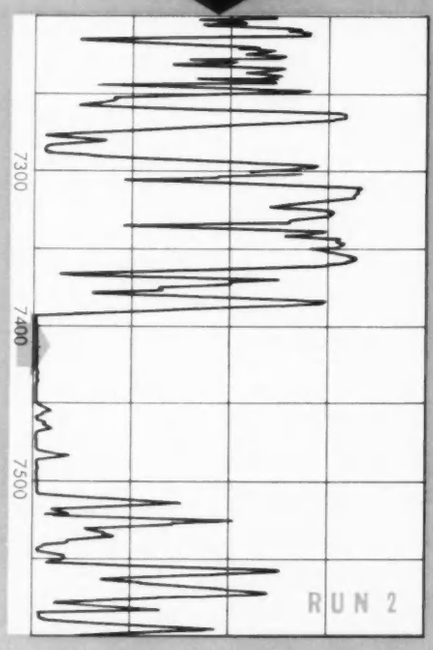
DOES THIS WELL NEED A SQUEEZE JOB?



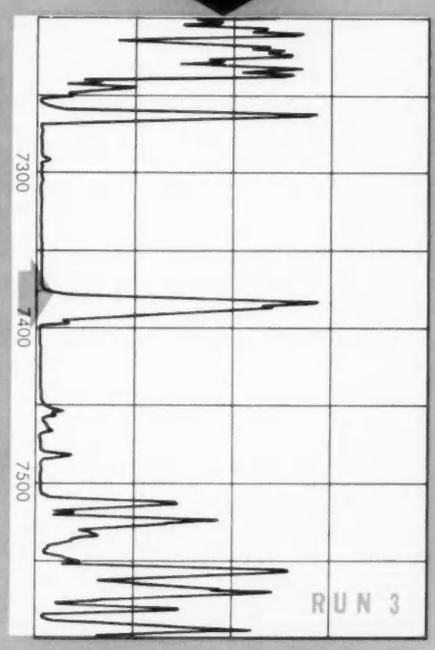
In this well, Lane-Wells Cement Bond Log showed no bonding in the zone of interest, indicated necessity of a squeeze job.

DID YOU GET AN EFFECTIVE SQUEEZE?



After perforating at 7414', well was squeezed with 88 sacks of cement. Second Cement Bond Log showed bonding from 7394' to 7510'.

DID YOU ISOLATE THE PRODUCING ZONE?



Well was perforated at 7378' and squeezed with 100 sacks of cement. Third Bond Log showed good bonding from 7269' to 7378'. Oil produced in zone from 7382' to 7390'.

Lane-Wells Acoustic Cement Bond Log

helps establish cement effectiveness with minimum equipment–without costly delays

Because it helps you "see" the cement column in a potential producing zone, Lane-Wells Acoustic Cement Bond Log is your best way to answer questions like those above. Run immediately following a primary cement job or prior to remedial operations, it can save rig time and avoid costly losses.

ACCURATE Significant information is contained in the first arrival signal, and all Lane-Wells units are equipped with an oscilloscope for viewing the acoustic signal at the receiver to assure pick of the first arrival.

ECONOMICAL More and more Lane-Wells Cement Bond Logs are now being made from single conductor equipment run from completion units, *an exclusive Lane-Wells service.* There is no delay in changing trucks. Bond log can be run immediately prior to perforating, from the same unit, or can be combined with other completion services for maximum speed at the rig. Equipment is now in service in 3⅝" size, and the 2" tool is becoming available in many areas.

Ask your Lane-Wells representative for further information on this time and money saving service.

LANE-WELLS CO.
P. O. BOX 1407 HOUSTON 1, TEXAS
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OIL · GAS · CHEMICAL · ELECTRONIC · INDUSTRIAL

We don't change the name...we change the performance

Regardless of how well a bit performs, our engineers are never satisfied. They are continually challenged by facts from research and the field to find new ways to increase footage and penetration rate.

Seven recent improvements in the already highly versatile, fast-drilling OWV have made it an even better performing bit. These improvements include:

1) Strengthening of bearing pin. 2) Increasing thrust bearing capacity to assure better bearing alignment during life of bit. 3) Improvement of metallurgy of roller bearings. 4) Development of new hard pad design to protect roller races from "shirt tail" wear. 5) Improvement of cone design to assure a better-balanced cutting structure. 6) Improvement of hardfacing to provide greater resistance to tooth wear. 7) Improvement of balance between bearing capacity and cutting structure to assure longer bit life and permit heavier weights to be used.

The result: more hole per bit at a lower cost. For the most economical hole you can drill . . . go all the way with Hughes.

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